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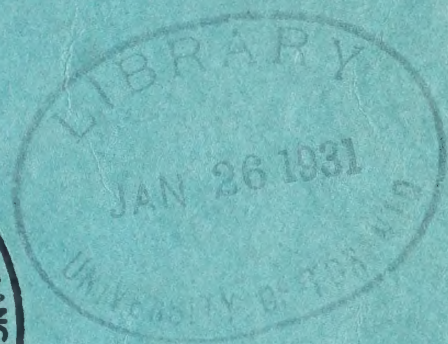
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DEPARTMENT OF THE INTERIOR
Thomas G. Murphy, Minister W. W. Cory, C.M.G., Deputy Minister
NORTH WEST TERRITORIES AND YUKON BRANCH
O. S. Finnie, Director

KEEWATIN AND NORTHEASTERN MACKENZIE

A General Survey of the Life, Activities, and
Natural Resources of this Section of
the Northwest Territories,
Canada



F. A. ACLAND
Printer to the King's Most Excellent Majesty
Ottawa
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NORTH WEST TERRITORIES AND YUKON BRANCH
O. S. FINNIE, *Director*


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Natural Resources of this Section of
the Northwest Territories,
Canada.

By
G. H. BLANCHET, B.Sc., D.L.S., F.R.G.S.



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KEEWATIN AND NORTHEASTERN MACKENZIE

INTRODUCTION

Northern Canada is receiving increasing public attention. The aeroplane has enabled many people to fly over vast tracts of the northern woodland and the open plains beyond reaching to Hudson bay and the Arctic. Reports brought out as to the character of the country, its climate and resources are sometimes of a conflicting nature.

In the following report, the treeless northern plains, which have been also called both the "Barren Lands" and the "Arctic Prairies," are described as they have been found to be by close observation at many points and at all seasons. Both the possibilities and the limitations of the country are considered in an endeavour to advise those interested in its resources as to what they may find, and to forewarn the traveller and investigator of what he must meet. The treeless portion of the northern plains comprises about 400,000 square miles, and the woodlands which separate it from settlement in the south and the mountains in the west are about 800,000 square miles in area.

There is a normal expansion of settlement and development from the prairie and park lands of the south into the bordering woodlands. The interest in the Far North is in its extraordinary resources. In the past these have been chiefly fur and the whale fisheries of its coastal waters. To-day it has attracted the attention of mining interests which have undertaken a combined aerial and ground exploration for minerals. The necessity for the observation of exposed rock sets a limitation on prospecting to-day in the North where only a comparatively small portion of the country rock is uncovered. A development of geophysical methods for mineral detection would open up vast new areas for prospecting and more intensive methods may result in many new discoveries. The present operations in Northern Canada have done much to arouse public interest and to cultivate a better understanding of the country as it is, dissociated from misconceptions of the Arctic.

PHYSICAL CHARACTERISTICS OF THE COUNTRY

TOPOGRAPHY

The striking feature of the northern plains of Canada is their uniformity. Inland from Hudson bay and the Arctic ocean there is a gradual change from a coastal plain which has recently emerged from the sea to an interior plateau across which the ice-sheet of glacial times forced its way and scraped off the soil and softer rocks. Both the coastal plain and the plateau exhibit the characteristics of new land. River valleys scarcely exist but drainage gathers into depressions as lakes, and discharges in turbulent streams. The land, for the most part, is covered with a mantle of glacial debris which gives a smooth rounded outline to the topography. This is broken in places by island-like areas of bare rocky country and by hills of glacial origin—moraines, eskers, and drumlins. Long slopes lead from the seacoast to the broad summit of the plateau on which the larger lakes have an elevation of about 1,300 feet above sea-level.

The direction of glacial movement throws considerable light on the local topography. The chief centre from which this movement spread has been placed by J. B. Tyrrell,¹ who explored this area for the Geological Survey of Canada, as east of Dubawnt lake. The ground record in striae on the rock and the direction of eskers is sometimes confusing, due to secondary movements of a local nature. The country when viewed from above is observed to have a furrowed appearance and these furrows are consistent in their general direction in any locality. The directions noted on various flights about the country support the ground observations fairly closely, assuming the centre of accumulation to be an extensive area. South of Chesterfield inlet the direction of glacial movement varied from 10° south of east, at the north, to 20° south of east at Eskimo point. North of Beverly lake the furrows hold a course of about 25° west of north. In the vicinity of Aylmer lake they are 65° west of north, while in the country between Great Slave and Athabaska lakes they are southwesterly. The direction of the furrows plays an important part in the drainage of the



TOPOGRAPHY OF UPPER MAGUSE RIVER

The Eskimo name for this country is "the place of the hills." This is in contrast to the flat, featureless plain bordering Hudson bay south of Dawson inlet, which is about fifty miles wide.

country. Glacial movement ignored country slopes and local topography, and the furrows made by it often lie across these slopes.

The foundations of the country are grey or light-red granite or granite gneiss, for the most part lightly covered with glacial debris. Between Rankin and Dawson inlets there is an area of crystalline schists, lavas, and quartzites which extend inland to the vicinity of Kazan river. The distribution of rock of this nature is irregular and it tends to produce a rough local topography. A red sandstone is found south of Baker lake and along Thelon river and reaches the west shore of Dubawnt lake. It gives rise to a sand plain of little relief through which Thelon river flows in a well-marked valley in which it has almost cut its channel to grade. Its headwater streams take their rise on the summit of the plateau near waters draining into Great Slave lake. An immense amount of sand is carried down Thelon river and deposited in Beverly lake which is separated from Aberdeen lake by a confusion of sandbars.

¹ *Report of the Geological Survey 1892-3.*

Dubawnt and Kazan rivers are of a different character. They flow across the inner plateau in a north-northeasterly direction, almost at right angles to the glacial furrowing and at an angle to the main country slope towards Hudson bay. They both have the same general character and are made up chiefly of lakes of great irregularity which discharge tumultuously through the barrier ridges that hold the lakes. On either side of the main waterways stretch other lakes of all sizes and shapes. When viewed from above little or no indication of a river is seen among the lakes dotting the country. It is only at rapids that it can be identified. The general courses of these rivers are remarkably straight when their origin and nature is taken into account. Eastward of Kazan river, drainage into Hudson bay follows both the main country slope and the direction of glacial movements.

Chesterfield inlet and Baker lake penetrate two hundred miles into the interior at sea-level. Tidal action ends at the east end of Baker lake, but sea-going ships may sail as far as its west end. The line of this valley is



THE LAKES DISCHARGE UNCERTAINLY FROM ONE TO ANOTHER

A lake may have several such outlets leading towards different waters.

continued by Thelon river. Northward from Chesterfield the country rises to an elevation of about 1,000 feet, and is rocky and broken. In places it is difficult to cross these ranges, even with dogs. The hills are more scattered and lower between Wager bay and the Arctic coast. The headwaters of Quoich river, which flows into the westerly end of Chesterfield inlet, rise in high, rugged hills but to the westward the country settles into a sand-and-boulder upland, about 600 feet high, which drops in long moderate slopes to the sand plain basin of Back river. This plain extends to the eastward as far as Meadowbank river and, in crossing it, Back river expands into great shallow lakes. The upper portions of the Back and Thelon rivers both have the same general character. They rise on the summit of the plateau and make an abrupt descent to sand plains, across which they flow with few rapids. Between the two rivers lies an upland which finally is lost as it meets the interior plateau.

Between Back river and the Arctic coast at Bathurst inlet the drift-covered pre-Cambrian plain with moderate relief is sharply broken by the rugged mountains that form the seacoast. They start at the base of Kent peninsula

and extend southwesterly; to the east of Bathurst inlet they have a depth of fifteen to twenty miles and reach to about 1,500 feet high. South and west of Bathurst inlet the mountains subside into a high broken plateau. The evidence of old beaches showing the uplift of the coastal plain of Hudson bay and the



THE NORTHERN PLAINS IN SUMMER

The well-watered lowlands support an abundant vegetation which is enlivened by the bloom of many flowers.



A GROUND SQUIRREL'S BURROW

The fertilizing of the soil in the vicinity of the burrows results in a luxurious growth of hay which furnishes the squirrel's winter food.

Arctic ocean is strikingly shown on high islands and abrupt portions of the coast. The outstanding features of the coastal plains and the inner plateau are the lack of relief and uniformity and the thin mantle of drift that covers most of the area.

SOIL AND VEGETATION

The soil of the northern plains of Canada is of glacial origin. In the movement of the ice the materials which it stripped off the surface of the country were ground and mixed together, and in general the farther they were carried the finer the rock flour became. As the ice retreated by the melting back of its face, this material was deposited. The large post-glacial lakes and rivers reassorted the debris released from the ice but on the uplands this remained an unassorted mass containing clay, sand, gravel, and boulders varying from boulder clay to coarse sand and boulders. The soil of the country in the proximity of the source of the ice movement received little grinding and is generally of a coarse nature and boulders and rock fragments abound. Since glacial times the finer soil has been washed into the lowlands and frost action has produced some disintegration. In general in a large part of the eastern portion of the Northwest Territories, upland soils are coarse and are featured by boulders and those of the lowland have a finer surface, with more available plant food. The water from the melting snow runs off the uplands



A GRASSY VALLEY AMONG LOW ROCKY HILLS

Such valleys are resorted to by the caribou for food and shelter. In addition to the grass of the valleys, mosses and lichens grow on the hills.

while the soil is still frozen and in the early season much of the lowlands is swampy. The rainfall of summer is light. The coarse soil of the hills rapidly absorbs moisture while the finer materials of the valleys and flats retain it on or near the surface.

These conditions of soil particle and moisture produce the logical results in the vegetation. On the hills it is sparse and restricted largely to hardy types and primitive forms while on the plains vegetation is more varied and luxurious. The climatic conditions and proximity to cold seas set limitations that vary with the locality. The late spring and short summer are to a certain extent offset by the long hours of sunlight. The vegetation of the Far North carries its seed through the winter and drops it in the early summer on the moist thawed surface warmed by the almost continuous sunlight of the period. The seed is favourably placed for rapid germination and growth. The aspect of the country changes from brown to green in the space of a few days and successions of many-hued flowers bloom and fade. Early in August the summer green is changed to the brown of ripened vegetation. By the end of

August or early in September the vegetation again enlivens the appearance of the country as the frost brings out the yellow of the willow leaves and purple and red of the shrubbery.

There is a great variety in the vegetation of different parts of the country as the factors of soil, climate, shelter, and cold bodies of water change. There are sand-and-boulder uplands which may be called barren, and grassy



GROUND WILLOW

Along the small watercourses there is a heavy growth of willow of this type. If there is shelter the bushes may grow five or six feet high.

plains that are meadows. Although certain hardy types of vegetation grow in the open plains of the North, sometimes almost luxuriously, the country has little agricultural value from a field-crop standpoint. Cereals would not mature and vegetables can be grown only under very favourable circumstances. The plains have possibilities for pasturage. They support great herds of caribou and formerly many musk-oxen lived there throughout the year. The possibilities of a meat supply from domesticated herds may receive more serious attention in the future. The country would support almost unlimited numbers with the vegetation it produces. It is possible that caribou from the northern plains may compete with sheep from Australia and beef from the pampas of South America.

The condition at the tree line, where the forests dwindle to dwarfs and finally disappear, have been observed at a number of points. Aerial observation with its wider views throws some new light on the subject. Soil, temperature, moisture, and wind are the governing factors among which a favourable balance must be reached to permit tree growth. The forest sends its hardiest species to the tree line and these develop types best suited to withstand the conditions they meet. Spruce and tamarack are the only trees found near the edge of the woods and the spruce, in a dwarfed form, alone survives beyond. Occasional islands of trees far beyond the timber line show a response to a favourable situation.

The trees disappear first on the hill tops and survive longest in the sheltered, well watered valleys. When viewed from above the forests are observed to be more and more broken by bare spots and these enlarge until they join one another, leaving strips and islands of trees, which become smaller and smaller. Along the courses of the rivers, tree growth continues farthest and the river courses form tongues from the forests, extending out into the open plains. The wooded valleys of dark spruce are first replaced by the light green of willow

and black birch bushes, and finally, grass and ground shrubs. The small streams usually spread over wide, stony beds in many small branches and at these there is a thick low growth of willow, flattened against the boulders. Moisture and plant food carried by running water account for the growth farthest out in the open plains, and the factor of shelter from the wind is most important in the last clumps of trees.

Along the course of Thelon river from Hanbury river nearly to Beverley lake there is an almost continuous strip of forest responding to soil, moisture, and the shelter of the valley. At Padlei on the headwaters of Maguse river in a country of high, rocky hills there is an area of several square miles of spruce and tamarack, far from the timber line. There are other similar widely scattered islands of trees about the headwaters of the rivers flowing to Hudson bay, south of Maguse river. In the country beyond the timberline and beyond the outlying islands of trees the localities in which conditions are most favourable for growth are featured by willows, black birch bushes, shrubs, and grass. Trees are lacking entirely.

The point has been raised as to whether the forests are advancing or retreating. Any general movement would be so slow that it is lost in the record of existing trees. The evidence on the ground is of an endeavour to advance by dwarf types, among which the number of dead trees shows that periodically unusually unfavourable conditions prove to be too much for the stragglers.

WATER-POWERS

The waters that accumulate on the interior plateau discharge from it in all directions by rivers characteristic of the slopes down which they flow. On the long moderate grades east and north the rivers consist of a series of lakes joined



KAZAN RIVER AND A POSSIBLE WATER-POWER PROPOSITION

The stretches between the lakes of the larger rivers contain many potential water-powers.

by turbulent streams. On these, water-powers are numerous but in general comparatively small, and it is impossible to effect concentrations. Only a small part of the available powers of the rivers can be utilized, but, on the other hand, their wide distribution makes them available for local needs almost

wherever they may be required. West and south the drop from the plateau varies from steeply graded to abrupt and the situation for power development is favourable; in some cases a large proportion of the available power could be utilized.

Water-power developments in the rivers of the Far North would involve difficult problems on account of the long season during which they are frozen and the generally quick run-off of flood water in the early summer.

MAPPING

In so far as its principal topographical features and essential characteristics are concerned, northern continental Canada has been explored to the extent that no new major feature remains to be discovered. Its principal rivers have been traced from their sources to the sea and the larger lakes are known and have been mapped with a varying degree of accuracy and completeness. Most explorations have followed the waterways and these furnish useful routes across the country. In the matter of detail, tributary streams, secondary lakes, and the intricacies of island and shoreline, much of the country between Mackenzie



AN AERIAL TRACK SURVEY

Whenever possible a landing was made about noon to fix the position by sextant observations.

waters and Hudson bay is practically unmapped. The simple waterways of the map are lost in the confusion of unmapped lakes and rivers. The lakes of the northern plains are countless and most of these discharge their waters into the main river systems.

It is necessary to have more knowledge of the topography of the country to assist in administering its affairs and in developing its resources. The tremendous area involved and the physical difficulties of work and travel make it practically impossible to undertake to map it by ordinary methods. In the past the method of exploring the country by making track surveys of its main waterways was an economical and effective way of meeting existing needs. For aeroplane travel and the wider interests of to-day, the narrow line of the track survey, with country totally unmapped on either side, gives too little information.

The situation may be met by the track survey method, using the implements of to-day,—the aeroplane for travel, and the aerial camera for record. Ground positions established by the canoe track survey are sufficiently accurate for present requirements to supply controls. Detail could be furnished by

oblique aerial photographs taken in a flight along the waterway, from which a wide strip of country could be mapped, and in addition the photographs would make a valuable record of the nature of the country, rock exposures, conditions at the edge of the woods, water-powers, etc. A series of aerial explorations following the principal rivers and coastlines would increase and strengthen the information of the map and add greatly to the knowledge of the country and the cost would be comparatively small. Such aerial explorations following Kazan, Dubawnt, Taltson, and Thelon rivers on the south and Back, Yellowknife, and Coppermine rivers on the north, would furnish fairly accurate maps of the aerial travel routes and would add very greatly to the knowledge of the unknown country between them.

The coastlines of Hudson bay were surveyed originally by ships which were forced to keep many miles out to sea to avoid the treacherous coastal waters. Much of the coast is low and details, other than the main indentations and headlands, could not be obtained by this method. The latitudes determinations are quite accurate but longitudes are weak. The coastline northward from Rankin inlet, as mapped from these early surveys, is shown too far west, the error being about five miles at Chesterfield and it increases to the north. Some corrections



UNLOADING CARGO

At all the settlements along the Hudson Bay coast cargo must be lightered ashore, and on shallow beaches this may only be done at high tide.

were made later from track surveys carried on in small craft, whale boats, and canoes, but although these could follow inshore waters, navigation was difficult among the reefs and islands. The rise and fall of the tides constantly changes the shoreline according as the extensive tide flats are exposed or covered. Even to the nearer view the coastline stretches away in a confusion of bays and headlands, islands and shoals.

The early mapping was a generalization, lacking detail and precision. In fact, complete mapping of the coastline would be extremely difficult to accomplish by water in summer on account of the tides, or on the ice, for the shoreline is very hard to fix where the land is low or where rough ice approaches the shore. The best results can be obtained by aerial surveys. The method adopted in the most recent surveys was to fix the positions of the main headlands and the bottoms of the inlets by observation and to get the detail by sketching when flying along the coast. Important errors in the shoreline were corrected, the largest of which was at Rankin inlet. The maps show it to extend inland over sixty miles, while actually it is only about twenty miles deep.

Along the coast between Dawson inlet and Eskimo point there are a number of peculiar islands and points, long, very narrow, and winding. These were observed to be eskers which feature the country for fifty miles inland. They are very striking here as the country otherwise is low and flat. The general depth of the deeps in Hudson bay is something over fifty fathoms. These approach to within ten or fifteen miles of the west coast, north of Eskimo point. The coastal waters inside vary greatly, and often quickly, in depth. Approaches to the coast are made with Eskimo pilots.



CHURCHILL—A WINTER VIEW IN THE HARBOUR

The various craft that wintered there were beached on the tidal flats and were undamaged by the disruption of the ice in the spring.

Good harbours for ships, that can be safely entered, are scarce and land shelter is almost lacking. Chesterfield is situated on a wide bay, open to the east and completely exposed to storms from this quarter. Fairway island lying a few miles to the southeast is marked by a beacon. Formerly whalers wintered at Marble island. On its southwest coast there is a sheltered bay with a narrow channel leading to a landlocked harbour. This is no longer used. When sailing along the coast a wide berth is given to Marble island on account of reefs to the southeast from it. The island is composed of quartzite which makes it a striking landmark. At Term point there is an excellent harbour with a good approach. This was also used by whalers for winter quarters. South and west from Term point there are many islands. The most easterly of these is well situated for the location of a beacon to mark the locality and also to give warning of reefs lying off it to the east. Tavane lies near the bottom of the wide bay between Term point and the north point of Dawson inlet. It is approached by a deep channel with reefs and islands on either side and has a well-sheltered harbour.

Between Dawson inlet and Churchill the coast is low and the bordering waters are generally shallow. The only point at which it is approached by steamers is at Sentry island off Eskimo point. Sentry island is an esker and the establishment of Eskimo point is situated on a deep narrow bay between two eskers. There is sufficient water to enable a steamer to enter this bay if the channel were marked. At present the steamers bringing freight to this post lie off Sentry island and lighter ashore. Northward from Chesterfield there is an old whaling station at Depot island at the mouth of Winchester bay

and another at Fullerton where the police formerly maintained an establishment. Fullerton has an excellent harbour but the entrance is among islands and reefs. Both Wager and Repulse bays may be reached by ship. The navigation of these waters is made with the aid of Eskimo pilots.

A number of ships with draught up to thirteen feet have sailed up Chesterfield inlet and crossed Baker lake. There is a heavy tide-race up Chesterfield inlet which just reaches the east end of Baker lake. In the restricted waters passing Bowen islands, rapids form as the tide drops. This channel must be passed with the flood. The shallowest water found here (seventeen feet) was in the south channel, but it was reported to be deeper in the north channel, although the Eskimo pilots would not use the latter. The navigation of these waters could be made safe by a few beacons and by investigating certain localities.

MINERAL EXPLORATIONS IN THE NORTHWEST TERRITORIES

THE GENERAL SITUATION

The great horseshoe of pre-Cambrian rocks extends from Ungava, through Quebec, Ontario, Manitoba and Saskatchewan and northward to the Arctic ocean. In the Northwest Territories it occupies a wide belt stretching from



THE PROSPECTOR

Prospecting can be greatly assisted by the use of aeroplanes for observation and transport but the discovery of minerals still depends on the ability of the man on the ground.

Hudson bay to a line marked by the great lake series, Athabaska, Great Slave, and Great Bear. In this great area, islands of the later Huronian and Cambrian formations occur. To the west in Mackenzie valley and northward in the Arctic islands, the pre-Cambrian is overlaid with unaltered sedimentary rocks.

Mining experience in other parts of the pre-Cambrian belt where intensive prospecting has been carried on has shown that in general the granites and

gneisses do not contain minerals of economic importance other than non-metallics, such as mica, phosphate, and so forth. Most of the important discoveries have been situated in the Huronian areas, and in these the larger areas are more productive than the smaller ones.

In order to have a concentration of mineral, a certain general situation must exist. There must be the source of the mineral, igneous rocks of certain characteristics and usually evidence of disturbances with fracturing and so forth, and mineralization is associated with vein and dyke materials. In the broadest sense prospecting consists in first locating formation, the Huronian areas, then rock of a particular nature, the mineral bearer, and lastly a physical situation which has favoured concentration. Prospecting would be simple if it were possible to determine the nature of the rocks by surface inspection, but this is seldom the case. More usually the formations of most interest are buried by other rocks and soil cover, or are suggested only by small outcrops which may bear little relation to what lies below. There is no practical method of determining the value of what is not exposed, other than the elaborate and costly operation of diamond drilling in rock and trenching through the surface cover.

The old type of prospector was usually a man who had visited many mining camps and had observed the kinds of rock associated with minerals there and his practice was to travel about the country searching for similar occurrences. More recently, especially with men trained in the mining fields of northern Ontario and Quebec, prospectors have more knowledge of geology, and their methods are more scientific, but it is recognized that the element of luck still plays an important part in prospecting, in what nature exposes to view, and in the prospector happening to find the surface evidence.

When examining a known favourable field most elaborate and thorough study is made and even in proven mines new discoveries are made in the course of operations. With this background of knowledge of what methods have been employed and what results have been obtained in older mining fields, the present operations in the Northwest Territories must be considered as of a preliminary nature. A vast country is being examined rapidly under extremely difficult conditions of climate and operation. Its situation, far from established transportation, eliminates all but discoveries of great extent or great richness, and necessitates that the surface indications must be of a fairly obvious nature. The expeditions engaged on the work are organized to be very flexible. The aeroplane with its great range and high speed sweeps the country and prospectors are moved about rapidly to examine areas selected by aeroplane observation. They may be widely scattered or concentrated in a small field as circumstances dictate.

Operations in the Far North can only be undertaken to-day with faith in the service of the aeroplane for this work and with hopes of a major find. Even from this point of view this work is of great interest and importance to Northern Canada. The results cannot be considered conclusive either as completely covering the country or as a thorough study of its rock exposures. Beyond the present investigations, there are the vast areas lightly buried in soil in which no examination is attempted, and in addition there are discoveries made which are not considered of sufficient importance to warrant further investigation.

Keewatin District was covered in a general way in 1928 and 1929. A large area of Huronian rocks had been found by J. B. Tyrrell between Rankin and Dawson inlets, extending some distance inland, and it was reported to be highly mineralized. This area was covered with some completeness by aerial reconnaissance and in many localities by ground parties. Mineralization was observed at many points but in small quantities, and with the general situation unfavourable. In the language of the prospectors, the formation is "too tight." Veins are usually small stringers and large mineral bearing intrusives are lack-

ing. The situation is somewhat more favourable farther inland but there rock exposures are smaller and less frequent. Northward from Rankin inlet the formation is largely granite and gneiss and was not considered favourable for minerals. Investigations were carried on as far south as Maguse lake.

Two discoveries were made along the Hudson Bay coast that were considered of sufficient interest to stake claims. The Nipissing Mining Corporation staked and mined a small gold deposit on Term point. A small rich pocket was found here but no further values have been revealed by their operations. On the north shore of Rankin inlet a party of the Cyril Knight Prospecting Company discovered and staked a pyrrhotite deposit and have carried on investigations by trenching. The outcrop occurs on the coast, and inland it is lost under the soil cover and it will require further work to prove its extent and value.

No further discoveries were made in the area covered and results have been considered of such a nature as not to warrant further study of the Hudson Bay coastal plain by the large operators. There remains the country south of Maguse lake and westward of Kazan river in which no investigations have been made. The country included in the Arctic slope from Repulse westward to the Bathurst mountains is of the same general character as far as it has been observed. It is in general a low, heavily-eroded pre-Cambrian plain to a large extent overlain with glacial material. It, too, has been dismissed as unpromising in minerals.

As a result of the two years' operations the Hudson Bay slope and the Eastern Arctic have been classed as not justifying further the work of mineral exploration, and attention is being concentrated on the western side of the pre-Cambrian belt, working from bases along the Mackenzie system and in the Western Arctic. This country of the height of land has many advantages from the prospecting point of view over the eastern section. It has the benefit of the established transportation system down Mackenzie river with its large lakes for distribution. It is for the most part wooded and on account of its altitude and greater relief there is a greater proportion of exposed rock, and in certain areas this is known to be of a favourable nature.

The sedimentary igneous contact follows the valley of Slave river and crosses Great Slave lake by North arm. Between there and Great Bear lake it holds closely to the waterway made up of Marian and Camsell rivers and connecting lakes. It crosses Great Bear lake in a northwesterly direction. Unlike the Hudson Bay and Arctic slopes which are long and gradual, the westerly descent from the plateau is abrupt. It drops through rough broken country to the level of the sedimentary plain. Bases situated at Stony Rapids at the east end of lake Athabaska; Fort Reliance, at the east end of Great Slave lake; Hunter bay and Confidence, at the east end of Great Bear lake, and Coppermine and Burnside, on the Western Arctic, furnish excellent points from which operations can be carried on into the country and which are in reach of established transportation. From Mackenzie river mineral explorations can also be made westward to the east slopes of the Rocky mountains.

This is the situation for the third year of the aerial mineral exploration of Northern Canada. Operators are handicapped by the general depression affecting the mining industry which is resulting in restricting investigation to smaller areas and working on a less elaborate scale. Work of a more intensive nature is planned for districts in which promising discoveries have been made.

TRANSPORTATION

The present transportation services maintained in the Northwest Territories are essentially those of the fur trade. A ship visits Hudson bay each year and calls at the trading posts. Small auxiliary sail boats handle local distribution. Similarly on the Arctic coast an annual steamer proceeds as far east as

Cambridge bay and smaller boats carry supplies farther eastward. In the interior two or three trips are made down the Mackenzie river by flat bottom steamers with scows. All these northern freight services arrive late in the season making it advisable to plan a year in advance in order to be equipped to take full advantage of the season. Aeroplanes can bring in the men before the season of navigation opens. There has recently been inaugurated a mail-passenger aerial service down Mackenzie river to Aklavik which operates throughout the year excepting during the season ice is forming and breaking up.



EXPERIMENT WITH A TRACTOR

This trip was from Churchill northward along the sea ice. By including a caboose, such operations are almost independent of weather and may be carried on in comparative comfort.



PLOUGHING A ROAD THROUGH THE DRIFTS

A tractor that could ride over the drifts would be more successful. It would avoid the necessity of ploughing roads and maintaining them which becomes prohibitive on long journeys and among boulders and rough ice.

A railway reaching Mackenzie river at the outlet from Great Slave lake would advance the season of navigation down Mackenzie river by five or six weeks in the spring and would also extend it somewhat in the fall. Existing transportation meets present requirements but would be unable to meet any large unexpected call upon it. It will be necessary to provide for any such situation that may develop through mining activities as the nature of the case warrants. In the meantime the aeroplane is furnishing the extraordinary transportation services.

Two interesting experiments have been tried by the Hudson's Bay Company, both with a view to simplifying transportation into the Eastern Arctic. An attempt was made to move freight from Wager on Hudson bay to the Arctic at the mouth of Cockburn river. The work done to date is of an experimental nature. The greatest difficulty was found to be selecting the most suitable type of tractor. Otherwise no serious troubles were experienced due to climate or the terrain. They also made an attempt to solve the baffling problem of the Northwest Passage by sending a ship, the *Fort James*, into the Arctic from the east by Bellot straits.

Northern Canada is a good field for the use of tractors to meet a local transport need or for preliminary development work, especially in winter. One of the most important considerations is to select the most suitable type and this varies with the particular operation. For comparatively short hauls where it is possible to provide ice roads the truck type does well. It can handle big loads and make fast time and is simple to operate. On lakes and rivers in the woodlands where the ice is smooth and the snow is soft, when the truck is furnished with a snowplow, it can make its own roads.

When it is proposed to operate over rough country and over hard snow of the open plains of the North and the rough landfast ice in the Arctic and Hudson bay the truck is not suitable. The labour of opening up roads for long distances and keeping them open becomes prohibitive. For such work tractors and trailers should be selected of a type that will ride over the hard snow. Probably the tank idea of tractor could be adapted for this work and trailers in the nature of toboggans might be found suitable.

THE AEROPLANE

THE AEROPLANE AND NORTHERN CANADA

In the exploration and development of northern Canada great distances must be travelled and it is necessary to take advantage of a short season. Transportation facilities of a very limited character are provided on certain main highways but beyond these the primitive methods of canoe and dog-sleigh must be resorted to. Into this field the aeroplane came as a solution to many problems, the open highways of the air permit travel in any direction, the speed of the aeroplane almost eliminates distance, and by it the isolation of remote parts of the country is removed and its resources are opened for investigation.

During the last decade the aeroplane has been employed to an ever increasing degree for work northward from settlement, both as a means of transportation, and for observation of the country and record of its features by aerial camera. At first all such work was undertaken by the Government through the Royal Canadian Air Force. Then private companies were formed to provide aerial transportation. Finally, companies possessing large scattered interests decided that it would be to their advantage to possess their own aeroplanes.

AERIAL PROSPECTING

The feature which has chiefly attracted private interests into the Far North has been the search for minerals. It has been found that the aerial view of

the country reveals things which cannot be detected on the ground. The buried remains of ancient cities may be indistinguishable on the ground from the local topography, but when viewed from above the comprehensive picture is unmistakable. The same results are obtained in observing rock formations. It is difficult on the ground to trace the continuity of a particular formation or to note the significance of adjacent ones. By painstaking study and survey a map may be prepared which will reproduce the country as it appears from above. A great deal of work is involved and it is often a matter of luck whether or not this work is done in the most important area. It is only at its conclusion that the situation may be judged.

On the other hand, if the process is reversed, a much more reasonable procedure is followed and more effective results should be obtained. From an aeroplane the country is examined and the trained aerial geologist can read the surface evidence. The rocks may be generally classified; intrusive bodies are clearly seen and structural disturbances, bending, folding and faulting are obvious. From the observation it can be decided what the nature of the rock is and what action has taken place. Knowledge on these two points is sufficient for him to decide in a general way whether or not the situation is favourable for the occurrence of minerals. It is usually the case that only a small percentage of an area examined will be selected as favourable. To carry on the investigation, ground work is necessary. Observations must be verified and theories and conclusions proved.



THE AEROPLANE FURNISHES DIRECT CONTACT BETWEEN THE BUSINESS MAN AND HIS FIELD OF INTEREST

The arrival at a far northern base of company officials on an inspection tour.

The advantage of the aerial method is that by it efforts are confined to those areas which offer the most chances for success. Its weakness may be in being too superficial, on account of the speed of travel and difficulties of aerial navigation in some parts of the country. The soundness of the method depends on the ability of the aerial geologist to determine the nature of the rock formations from above with sufficient accuracy to decide whether these should be classed as favourable or unfavourable for the occurrence of minerals. The practice should be one of broad classification. Areas with no rock exposures can be dismissed at once. Areas in which the formations are massive and

unbroken may be classed as unpromising while those areas in which from the rock formation, or from indications of action through it there are probabilities of mineralization, should be selected for further study on the ground.

In general this is as far as the aerial investigator can go but it is an important step forward in investigating great areas in which transportation and travel are difficult. It enables the prospectors to confine their operations to sections of the country in which the chances for success are greatest. Occasionally direct evidence of mineralization may be observed from the aeroplane. This is usually a rusty stain due to the presence of iron. In such a case a landing may be made and the discovery investigated.



AERIAL PROSPECTING

When an area has been selected as promising for minerals, prospectors are transported to it and supplied with provisions and other necessities by aeroplane.

The aeroplane is also the vehicle by which prospectors are taken to selected areas and supplied with necessary equipment. The machine used for investigation can service a number of ground parties and an elastic organization is maintained which permits intensive investigation in one locality and a rapid generalization in another. In a broader sense the aeroplane has brought revolutionary changes into mineral investigation in Northern Canada. Formerly the possible range of a party in a season was limited and the time which could be spent in study was comparatively short. The limit of practical interest beyond established communication was soon reached and only finds of exceptional value justified further efforts to investigate them. This left much of Northern Canada beyond the field of practical interest.

With the aeroplane the situation is fundamentally changed. Prospecting may be carried on practically anywhere in the North and great areas may be covered in a season. Experts can be flown in to examine and report on discoveries and the proposition, reduced to costs and estimates, can be submitted almost at once to boards of directors for action. Should it offer sufficient promise the necessary equipment for preliminary investigation can also be brought in by aeroplane and at a comparatively small cost the value of the discovery can be proved or disproved. This not only gives quicker action and reduces the cost of preliminary work but it permits the investigation of prospects that would

formerly have been impossible with the prohibitive cost of transportation and it saves heavy losses for such work that results have not justified. The aeroplane has been used efficiently to transport many tons of materials required for the early development work at a mine, notably at the Sherritt-Gordon mine in northern Manitoba.

FLYING CONDITIONS

Flying is largely controlled by visibility. The winds of summer have little effect other than by roughening the surface of the water, making more difficult the take-off and landing. In winter any wind stronger than about fifteen miles an hour starts the fine dry snow drifting and the drift mounts as the strength of the wind increases. The sun may be shining and the upper air may be clear but the drifting snow, by making it impossible to see the ground for landing, prohibits flying. Low temperatures introduce difficulties in starting the engine, and protection must be provided to prevent too much cooling when flying but otherwise the cold may be ignored.



AEROPLANE NOSE HANGARS

In the North where it would be out of the question to build large hangars, this arrangement permits housing the engine in a small, heated building where it may be overhauled. A still more temporary hangar can be made of a large tarpaulin heated by plumbers' lamps. These are used for heating the engines in cold weather. The oil which is drained on landing is heated separately. The warming-up operation is essential and requires an hour or two.

In classifying flying conditions the following arbitrary divisions are used:—

“Nil” applies to misty weather, with little or no visibility, gales in summer and drifting snow in winter.

“Poor” chiefly refers to visibility. Flights might be made under such conditions when following a well defined landmark such as a river, but practically no observations could be made.

“Fair” and “Good” broadly include all flying weather safe for navigation and suitable for observation.

A daily record was kept at Tavane during portions of 1928 and 1929, covering a period of twelve months, with the following results:—

Spring (April 16 to June 15), ski equipment, ice landings, snow just leaving the land towards the end of the period:—

	Nil	Poor	Fair	Good
April 16-30..	5	3	3	4
May 1-31..	10	8	4	9
June 1-15..	2	3	3	7

Summer (June 16 to September 15), skis to end of June, some loss of time while the ice is going out, then pontoons. Land clear of snow:—

	Nil	Poor	Fair	Good
June 16-30..	5	1	4	5
July 1-31..	4	2	3	22
August 1-31..	1	5	5	20
September 1-15..	4	4	2	5

Fall (Sept. 16 to Dec. 15), during the early part of this period ice forms on the lakes, snow starts to gather lightly in October and it is not until the middle of December that winter cold sets in to stay. Pontoons may be used into October on the larger lakes, when a short time is lost until skis must be used.

	Nil	Poor	Fair	Good
September 16-30..	6	8	0	1
October 1-31..	9	6	10	6
November 1-30..	12	2	5	11
December 1-15..	5	2	1	7

Winter (December 16 to April 15), this is a season of clear skies but flying is often prohibited by drifting snow:—

	Nil	Poor	Fair	Good
December 16-31..	6	6	0	4
January 1-31..	16	2	0	13
February 1-28..	7	4	4	13
April 1-15..	2	2	2	9

An important factor is introduced by the period of daylight—long in summer and short in winter. During July and August, flying weather is most favourable, and most effective work can be done and at the same time the general conditions affecting life in the open plains are easiest. As far as possible flights into Northern Canada follow well marked waterways which furnish guides for navigation and landing places. Ideas have changed rapidly as applied to such flights. In 1928 the journey from Winnipeg to points on Hudson bay was considered a remarkable one, while that made across the interior from Chesterfield up Dubawnt river to lake Athabaska was so outstanding that the pilot who made it was rewarded with the McKee trophy. The Mackenzie river route was flown down as far as Norman in 1921. The river furnishes continuous landing places and the numerous settlements and established transportation remove the danger which is attached to flying in other parts of the north in case of shortage of gasoline or engine failure.

Winter and early spring flying in the open plains of the North was found to be hazardous. The snow-covered lakes and sea and plain offer little for guidance and the surface condition of the snow strains the fuselage and under-

carriage when landing and taking off. So many new and remarkable flights were made in 1929 that they received little public attention and though aeroplanes were damaged, a splendid record was established in that there was no loss of life.

Among the outstanding flights made were the following:—

The west coast of Hudson bay was followed to Repulse bay and Rae isthmus was crossed to the Arctic ocean at Committee bay.

A number of flights were made from Baker lake to Bathurst inlet and along the Arctic coast.

Kazan river was followed from Baker lake to its source and the height of land was crossed to lake Athabaska.

Dubawnt river which had been flown in 1928, was used as a highway by many aeroplanes.

Interior routes between the east end of lake Athabaska and Fort Reliance at the east end of Great Slave lake were followed.

A number of aeroplanes travelled between Fort Reliance and Bathurst inlet.

Several flights were also made from Great Slave lake by Yellowknife river to the Arctic at the mouth of Coppermine river and between this point and Norman on Mackenzie river.

The Mackenzie route from the end of steel to Aklavik became an established one and flights were made from Aklavik to points in Yukon territory.



HUDSON'S BAY COMPANY POST AT PADLEI

The house here is built with trees obtained locally in an island of spruce and tamarack on the upper Maguse.

AEROPLANE PROBLEMS

From the experience of the year, summer flying even in remote sub-Arctic districts was proved to be comparatively safe with aeroplanes of good air endurance and pilots trained in northern navigation. The chief difficulties are the establishment of gasoline caches and the mists which rise from the cold northern waters during the period of the fall freeze-up and from the snow during the spring thaws. A chain of wireless stations established by Dominion Explorers Ltd. increased the factor of safety by furnishing weather reports and providing com-

munication. The establishment of aerial mail service to the mouth of Mackenzie river has been a further advance in northern flying and its successful operation removes the isolation of far northern settlements and will direct attention to the resources of the country along the route which is now so easily accessible for investigation.



CANOE TRAVEL, UPPER MAGUSE RIVER

The headwaters of the rivers flowing to Hudson bay are much broken by rapids. In the late summer the streams become very much reduced by the rapid run-off.

The possibility of crossing from Northern Canada to Northern Europe is frequently discussed and the experience now being gathered of weather and ground conditions in the north will be invaluable in throwing light on the practical side of the problem. It is through the continued use of the aeroplane on work of a practical nature on which it performs definite service with a reasonable degree of safety that public confidence is gained and capital is interested in its ventures. The spectacular dash draws attention to the dangers and to the personalities involved, rather than establishes confidence in the machine or the performance. From this point of view, pilots pioneering flying conditions in Northern Canada are performing a valuable service, and deserve a great deal of credit.

The ordinary commercial aeroplane was designed for conditions met with in the middle temperate zone. The chief problems of design are to strike an economic mean between strength and lightness and between power and gasoline consumption, with speed as an increasingly important factor. In the Far North both the conditions to be met and service requirements are different. Safety factor comes first as it does everywhere but ruggedness is more important than either pay load or speed. The landing gear, which is chiefly wheels in the South; must be pontoons for summer and skis for winter, in the North, which affect both strength and load. These matters are now receiving more attention than formerly, designs are being altered and better provision is being made for new stresses which must be met in the North. In cold weather the oil shock absorbers freeze, and this must be met by either a different type or by use of a different fluid.

Manufacturers are interested in the problem of designing an aeroplane to meet conditions peculiar to the North. The conclusions which were formed as

the result of the experiences of many pilots in operations covering a large portion of Northern Canada and carried on during the greater part of the year should assist in the solution of these problems. These may be classed as ground and aerial problems. Of the two those of the ground have given most trouble to meet and involve structural changes in the aeroplane itself to overcome them. Most important is that of the landing and take-off.

In summer, high-winds and lack of land shelter cause the surfaces of lake and sea to become very rough for pontoons and in winter the hard, roughly drifted snow produces the same condition. The undercarriage and fuselage are severely strained and in extreme cases it becomes impossible to land on such surfaces without damaging the machine, or to obtain sufficient speed to take off. Danger from this source may be reduced by strengthening the undercarriage and fuselage and by giving more attention to shock absorbers. This means adding weight and is only a partial correction. It is advisable in the interests of safety and service to go farther. The most reasonable solution is to reduce



DIFFICULTIES AND DELAY WERE CAUSED DURING FORMATION AND
BREAK-UP OF THE ICE

The limitations placed on operations by both pontoons and skis may be overcome by the use of landing gear of special design.

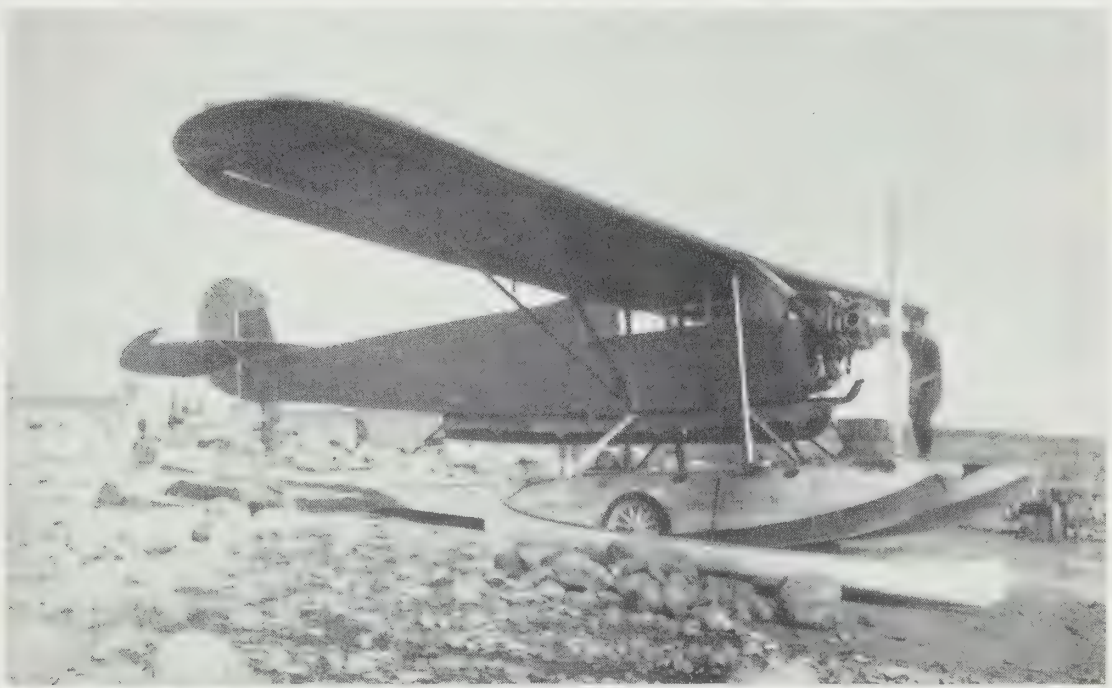
to a minimum the run on the ground, that is to obtain a quick take-off—more power—and a low landing speed,—more wing spread. This would require an aeroplane somewhat strengthened, with more wing area, more power and less pay load per unit of power than at present. Also its flying speed would be reduced.

In meeting the keen competition of to-day manufacturers are endeavouring to increase speed and pay load per horsepower to the limit of safety, but for a suitable aeroplane for northern service, safety should be featured at the expense of speed and pay load. Another problem is that of the disposal of load. In the standard type of cabin aeroplane it is difficult to get the weight of a bulky load sufficiently far forward. This can be provided for by somewhat increasing the cabin's height. The troubles resulting from this condition are sufficiently serious to warrant attention.

There is an important loss of flying time between seasons. Northward the lakes freeze earlier and thaw later. In the spring it is difficult to bring machines in from the South where they are using pontoons and a period of good flying weather is lost. Again in the fall they must leave the North early to avoid

the freeze-up. No attempt has been made to use landing fields other than water or ice. At the same time there are many stretches in the open plains which are no rougher than cultivated land, on which aeroplanes could alight with safety, especially if modified as suggested above to meet rough landing conditions. Interesting experiments are being carried on to test special landing gear to meet such conditions. This consists of very wide wheels with highly inflated tires which give more bearing and absorb the shock of minor irregularities. Such wheels have been used successfully on snow and soft ground and have decided possibilities in meeting the between-season problem in the North.

As in all forms of mechanical transport careful inspection and servicing is essential and the best types of men and equipment for this should be a first consideration. The ordinary light anchors are not sufficient to provide moorings in stormy weather. An anchor of at least fifty pounds of the mud-hook type should be carried and a length of chain should lead from the anchor to give the mooring line the proper angle of pull. On many northern lakes there



AEROPLANE WITH CANOE

This illustrates how a canoe is attached to the fuselage of a plane. Such canoes were carried on extended trips without difficulty.

are no beaches and the shore waters are shallow. It is necessary in such places to anchor in a safe depth of water and make shore with waders if a canoe is not available.

This question of carrying a canoe on aeroplanes engaged in northern operations has been given serious attention in Canada. The only previous attempt to provide an emergency craft was a pneumatic rubber boat. It required an appreciable time to pump air into it and the boat was difficult to handle but it did provide a craft for emergency landings. The type which was first developed in Canada was the sectional canoe. This was essentially a standard, canvas-covered, wood canoe cut into three sections with the open ends closed by bulkheads. To set it up the bulkheads are held together by clamps to re-assemble the original canoe. A good craft is provided in this way which is portable and still serviceable for travel if necessary. Its disadvantages are that it is very bulky and awkward to handle in a 'plane and some time is required to set it up.

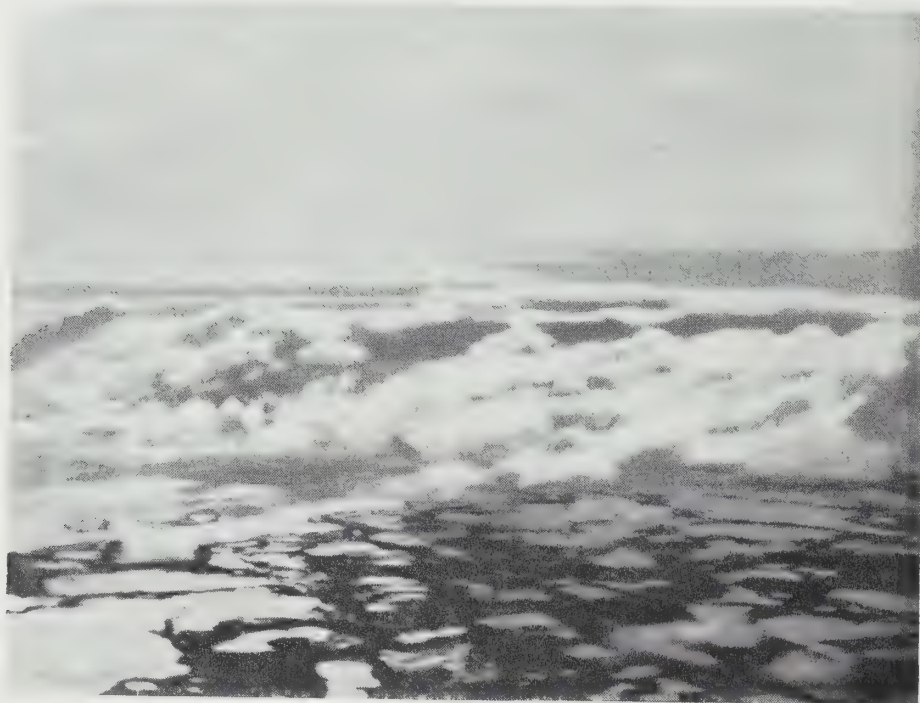
The latest attempt to solve the problem was the design of a canoe by Dominion Explorers to fit neatly against the bottom of the fuselage to which it is held by straps. Aeroplane manufacturers at first did not approve of the

idea, fearing that it might affect the performance of the machine in the air but a demonstration convinced them that it is practicable and during the last season a number of aeroplanes carried canoes of this type. The canoe is a good model for travel and is designed to carry a fair load. The only difficulties are the work of shipping and unshipping them, and a danger of water collecting in the canoe when taxi-ing on rough water.

FLYING PROBLEMS

The two most serious difficulties in flying in the Far North are those of navigation, due to the failure of the magnetic compass in the neighbourhood of the magnetic pole and those due to poor visibility at certain seasons.

Proceeding northward the vertical component of the magnetic force increases in strength while its horizontal component decreases. On the ground a compass free from local influences requires more compensation on its south end to keep it level and it becomes more and more sluggish until finally the directional force is not sufficient to overcome the slight friction of the pivot and it will

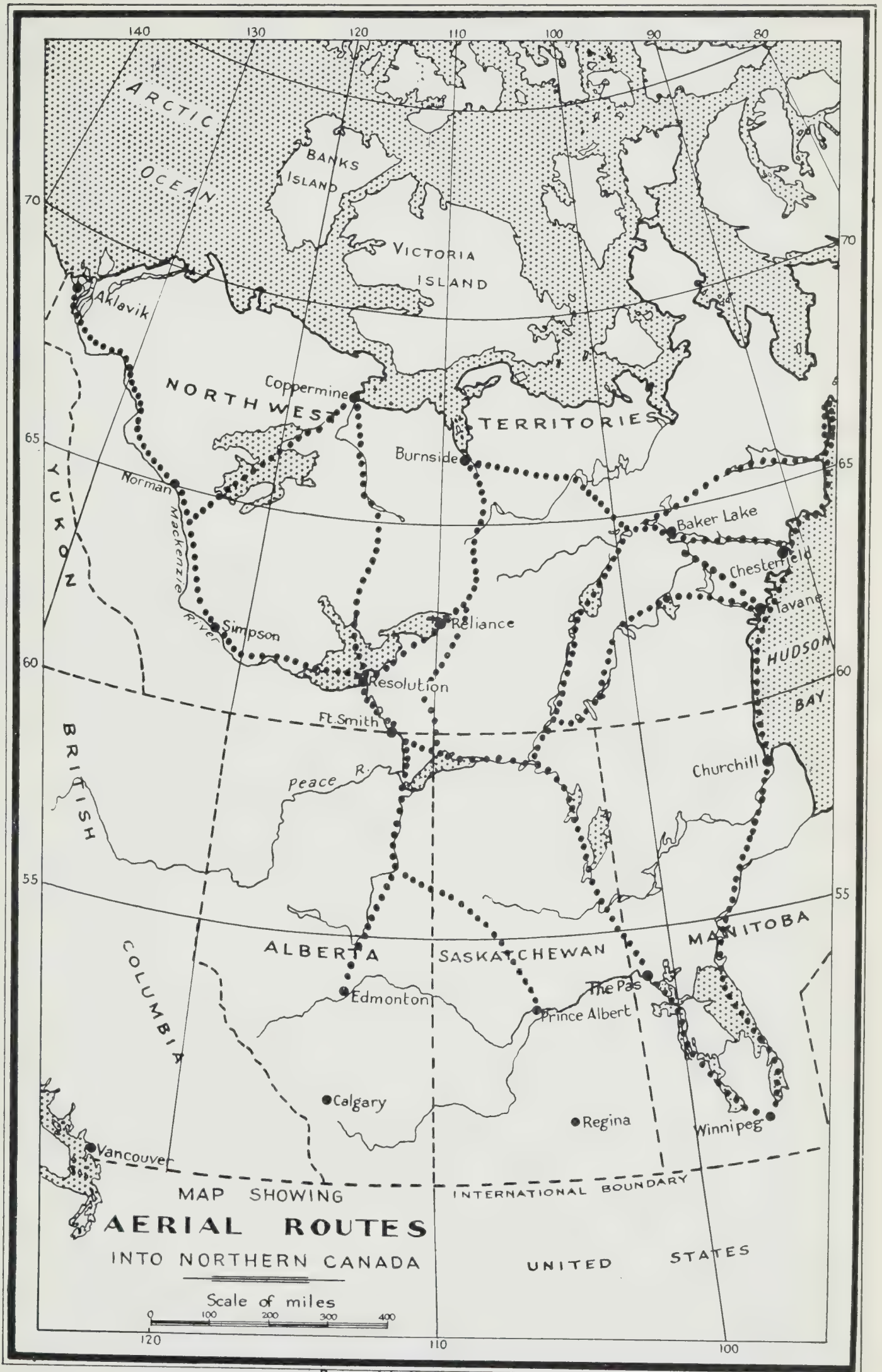


FLYING OPERATIONS—INNUMERABLE LAKES ARE DOTTED
OVER THE COUNTRY

Cross-country navigation is extremely difficult. The waterways are largely made up of lakes which are scarcely distinguishable among the confusing waters

come to rest in any position. In an aeroplane there is a strong local field due to the metal of the fuselage, the engine and the magnetos. The compass must be corrected for this by magnets, by the nautical method of "swinging the ship." These magnets, by increasing the strength of the local field, make it still more difficult for the weakened horizontal force to act in the North, and there is a limit beyond which the needle loses its directional quality, finally becoming demagnetized.

The ordinary grades of compasses when set in their usual position on the instrument board near the engine soon become useless. Better types of periodic compasses set as far as possible from the engine field and read by mirrors are more sensitive and will perform farther North. The sun compass, which is independent of magnetism, requires clear skies and frequent adjustment for geographical position and it is difficult to place it where it is clear from the shadow of the wings and convenient for setting and reading. Other direc-



Prepared by North West Territories & Yukon Branch - Dept. of the Interior

MAP SHOWING AERIAL ROUTES INTO NORTHERN CANADA

tional instruments are too heavy or otherwise unsuitable. The problem is a difficult one and must be solved in the interests of safety. Wireless direction-finding stations would meet the navigation situation best but necessitate the carrying of heavy equipment in the aeroplane. At present the pilot is forced to travel by the sun or by landmarks and if neither is available he must land and wait for more favourable conditions.

The greatest danger to flying in the North is the misty atmosphere which has been described as a prevailing condition of the northern spring and fall. The mist rising from open water forms low thin cloud banks which drift over the land with the winds. Beneath them the low altitude makes flying dangerous and navigation extremely difficult while above the clouds in bright clear weather navigation is reduced to dead reckoning, ground position becomes weak and landings through the mist are practically impossible.

THE ARCTIC HIGHWAYS TO EUROPE AND ASIA

The possibilities of the comparatively short aerial routes over the ice-bound Arctic have been considered by aerial authorities. Wilkins and Amundsen and Byrd have pioneered this field and their work has brought out both the difficulties and possibilities. More recently the flying operations of commercial companies along the Arctic coast and in the sub-Arctics has thrown new light on the subject.

The previous flights were in the nature of feats performed after great preparations and at a high cost. Those of the Canadian companies were made in the course of business operations and can be repeated at a moderate cost. Flights of the first kind require special equipment and are dependent on the most favourable weather conditions, while commercial operations are carried on with only slightly modified equipment and flying methods. It is by such work that public confidence will be established and the flying problems of the Arctic will be worked out. It is essential to have a rugged aeroplane designed to meet northern conditions, well established bases, with wireless communication and pilots and mechanics trained in this service.

The question of the possibility of safe landings on the polar ice is a controversial one. A small roughness of the ice is sufficient to damage the skis and a rough surface on the snow strains the undercarriage and fuselage. There is also the added danger of drifting snow or mist making it impossible to judge surface conditions from above. If the air is clear and ground visibility good an observer with knowledge of such surface conditions can form a good estimate of their suitability for landings and the best manner in which to attempt one. From present knowledge of Arctic ice surface conditions it may be generalized that they are best in early winter or in mild weather. Suitable landing places are probably numerous but it is essential that the pilot should have the necessary training to recognize them and that he direct his flight to keep a landing within range as he does with lakes in pontoon flying.

Forced landings may be successfully made by a skillful pilot even under bad conditions in many places where it would be impossible to take off or where a runway would have to be prepared. This brings up another important consideration which also applies to sub-Arctic flying. A pilot or some member of the crew must be trained to be able to care for himself and party if he should be stranded. Proper emergency equipment should be carried, such as tents, rifles, and fishing gear. If flying in winter, snow-knives should also be carried; he should be able to build a snow shelter and should understand the technique of hunting on the land or on the sea ice. The safety factor for such flying involves: suitable aeroplanes, wireless telegraph for communication, and, of most importance, men capable of meeting emergencies peculiar to the Far North.

CLIMATE

GENERAL CLIMATIC CONDITIONS

Meteorological conditions in the Far North are found to be an important factor in the weather phenomena of the temperate zone and are receiving more attention than formerly. There is a direct relation between high or low atmospheric pressure in the Arctic, and the frost danger in southern fruit-growing districts and Atlantic storms. It is claimed that forecasts of weather based partly on reports from northern meteorological stations have saved millions of dollars to shippers of fruit.

This service can be improved when more recording stations are scattered through the Arctic regions especially in Northern Asia to permit closer observations of the extent and movements of high and low pressure areas. Certain general conditions prevail. The Rocky mountains exert a tempering effect in the west, while the cold waters of Hudson bay produce the opposite result and, from the combined action of these, isothermal lines hold a northwesterly course



SNOWDRIFT FORMATION

The drifting snow hitting a building is deflected about its ends or carried back to form a breaker-like snowdrift.

across the country. The presence of the great body of cold water in Hudson bay gives a low yearly mean temperature but also moderates the extremes in the adjoining country. On the high plateau country of the interior the yearly mean is higher but there is a greater range. Periods of high temperature in summer and of extreme cold in winter are experienced.

The outstanding feature of winter in the Far North is the wind. In the woodlands it is not so important, as the trees offer shelter and prevent the snow from drifting, but in the open plains and on the large lakes even a fresh wind cuts off the fine particles from the snow surface and puts them in motion in a filmy sheet. Every boulder or other obstruction causes the driving snow to part and also, in the eddy in its lee, particles are drawn in and accumulate. In this way drifts form. If the obstruction is large, like a house, the wind-driven snow striking it curls back and is deposited five or six feet away in a breaker-like drift or it is carried around the ends.

As the winter advances and the drifts continue to accumulate, always with winds from the same quarter, they take the form of elongated horseshoes with the house near the closed end. Bare windswept ground a few feet wide extends around the house on three sides, with the drift rising vertically from it. Drifts form in the lee of low banks until the depression is almost obliterated. In the case of a high hill dropping abruptly to the southeast (the lee side) a tremendous drift accumulates which sometimes does not melt completely during the summer.

In the open plains the snow at first moves along the surface but as the wind rises the drifting scud mounts higher and higher into the air until it resembles a sand storm of the desert. This condition of high wind, driving snow and low temperatures, is that on which ideas of the severity of the Arctic winter are based. On the other hand such weather is exceptional in its extreme form and between storms there are often long periods of clear bright weather with the thermometer about twenty degrees below zero.



TAVANE IN LATE WINTER

In winter the drifts formed about the buildings and offered some protection from the wind.

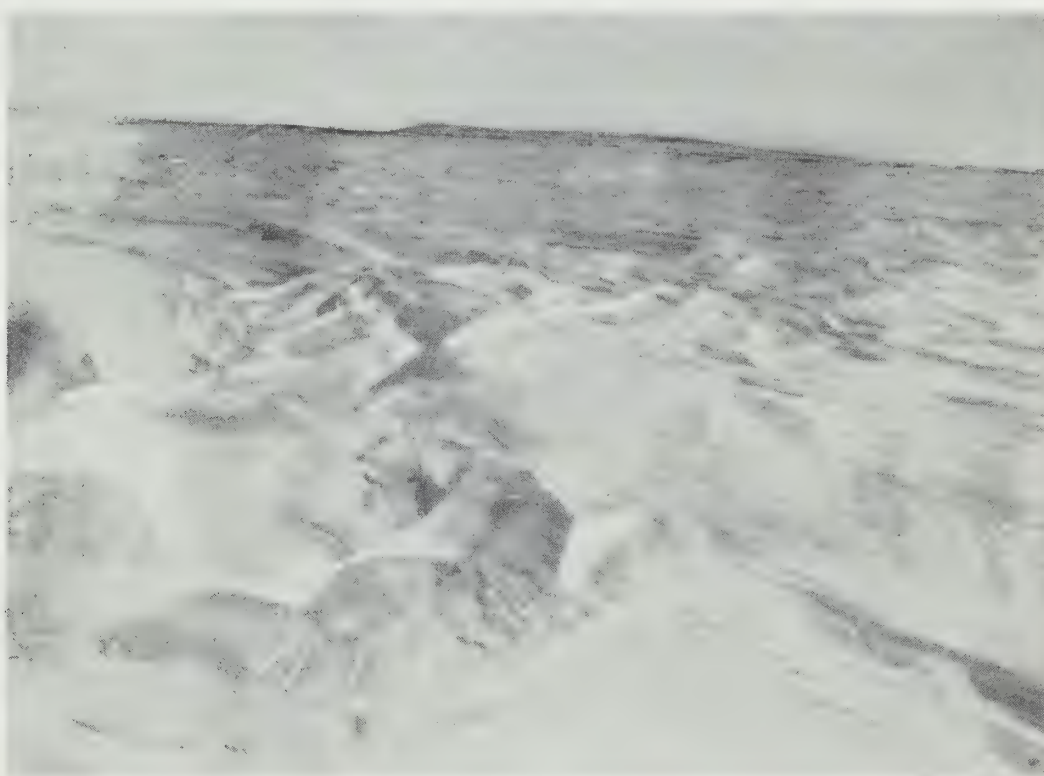
Records kept at Tavane reveal the following general conditions which apply to a large part of the area under consideration.

Summer reaches its height in July when the vegetation is in full bloom and the young birds are hatched. Winds of summer are usually moderate in strength and a strong wind does not last long. They are variable and may come from any quarter. By the end of the first week in August the flowers have faded and the vegetation matures. The summer ends in early September when vegetation dies and winds become stronger and more frequent and settle more and more to the northwest. Ponds start to freeze and snow squalls sweep across the country though there is no appreciable accumulation of snow during the early fall. Mists rise from the open water and hang low over the land during much of the period during which the lakes are freezing. These mists blanket the land and moderate the temperature at this season.

Autumn in the Far North includes the period during which ice forms on the ponds and the large lakes while the snow slowly accumulates and the temperature settles lower and lower until it reaches its winter mean level of 20°

below zero F. The advance of winter is slow and almost imperceptible and the moderate climate of autumn comes as a surprise after its tempestuous start in September. October and November are usually almost free from high winds and low temperatures. The Eskimo name for November means "soon winter comes." There is scarcely enough snow for travel or igloo building until December. Large lakes, such as Baker lake, may start to freeze at any time after the middle of October and shore ice sets in sheltered bays of the Arctic ocean and Hudson bay about the first of November.

The sharp frosts and mild spells of November change to below-zero weather and sharp frosts in December. It may reach 30° F or more below but only for a few days at a time. December is not a windy month; it may be featured by one heavy gale and several scattered windy days but light winds prevail during most of the month. The sun swings through an ever-shortening arc, low down near the southern horizon but there are long periods of twilight and dawn.



SURFACE CONDITIONS ON THE SNOW ON THE OPEN PLAINS

The snow is packed so hard that it is scarcely marked in walking over it and the surface is roughened, being whipped into wave-like drifts.

Conditions for travel have not yet become good by the end of December. Comparatively little snow has accumulated and on account of mild spells and lack of heavy winds this is not yet well packed. On the sea ice the cemented floes have not been smoothed over by the drifted snow and in rough tidal and rafted ice holes and cracks make travel difficult. In latitude 62° the December moon did not set. In completing its circle it just touched the northern horizon.

January is the month of the return of the sun and with it an increase in travel and outside activities. The thermometer normally does not register above zero; the mean temperature for the month is 20° below zero. In January, 1929, a sharp rise on the 26th lasted until the 30th during which 30° above zero was reached. Farther to the northeast is Baffin island and northward in Ellesmere island a similar sudden rise in temperature resulted in a thaw, while at King William island 15° F. above zero was reached. During this period the barometer was high and steady and it was marked by strong winds. This was the

nearest approach to a thaw during the winter; the thermometer did not again touch 30° above until the end of April. January was a fairly windy month with strong winds on fifteen days, but marked by a period of nine days of almost calm preceding the warm spell. Clear bright skies prevailed during most of the month.



MAGUSE RIVER IN SPRING

Ice forms during the winter to a thickness of six or seven feet and at the north bank a huge drift of snow accumulates on top of the ice.

February is considered by the Eskimos as the coldest month in the year. It had the lowest reading of the thermometer, 46° below zero F. and the lowest mean, 22° below. Clear skies, brightened by the returning sun, offset the cold and somewhat windy nature of this month.

March is also windy and bright with a slightly moderated mean temperature of 19° below and a greater range (maximum, 15° above, minimum, 39° below), due to the effect of the sun. This is an excellent month for travel with its long bright days and good snow conditions. The transition from winter's cold to the mildness of spring is a gradual one which takes place in April. By the middle of the month the temperature has risen above zero to stay. With the rising temperature the bright skies of winter are lost. The snow melts, to a large extent, by evaporation into the air and these vapours form low misty clouds. The northwest winds which predominated during the winter lose their force and persistence, and easterly and southerly winds bring heavy snowfalls, until by the end of April the snow reaches its greatest depth.

Spring begins about the middle of April with the moderation of the cold and the commencement of melting and continues through May and until the middle of June when normally the land is clear of snow and the ice is commencing to break-up in the lakes. The spring winds are variable and are seldom very strong. They may blow from any quarter with the westerly wind usually bringing fine warm weather. Travel on the land with sleighs ends about the 24th of May. The birds return during the early part of this month and by the middle of June vegetation shows renewed life.

From the time the land emerges from its snow cover in June until the first snowfalls of September, is the summer season. It is featured by the long hours of sunlight during June and July which give rapid growth and permit a wide range of flowers, grasses and shrubs to ripen to maturity.

The following table of mean monthly temperatures gives a comparison between Toronto and points in Mackenzie valley and on Hudson Bay:—

—	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Toronto.....	24	22	30	41	55	64	71	69	60	49	38	28
Fort Smith.....	−14	−10	2	23	41	55	58	56	48	30	12	−10
Good Hope.....	−23	−18	−10	13	38	54	60	53	39	21	−6	−20
Herschel.....	−22	−12	−12	2	19	35	44	41	31	16	−6	−14
Churchill.....	−18	−17	−6	15	29	42	52	52	41	26	7	−10
Tavane.....	−20	−22	−19	3	19	41	50	52	40	23	8	−8

The outstanding seasonal features of the climate of the west coast of Hudson bay are a long mild spring, with a great deal of cloudy weather, a short summer of rapid growth and fine weather, a long mild fall, misty at first then bright and cold, and a cold winter with clear skies broken by occasional high winds with drifting snow. It is only this latter feature—the drifting snow—that sets a definite limitation on outside activities, otherwise community life may be carried on throughout the year in the northern treeless plains much as it is in the settlements of the south.

SNOW AND RAIN

The normal precipitation in the Mackenzie valley is about 10 to 12 inches. In the country bordering Hudson bay records are scanty and it is probable that there are considerable variations in different localities and from year to year. The following records are available:—

- Moose Factory (33 years), mean precipitation, 21 inches.
- Churchill (45 years), mean precipitation, 17 inches.
- Port Nelson (15 years), mean precipitation, 14 inches.

Fifteen inches is a conservative estimate for the more northerly points on the west coast of Hudson bay. Rainfall is fairly well distributed from June to September, heaviest in August.



THE SNOW COVER OF NOVEMBER

Except for the drifts the land is lightly covered with snow until Christmas, after which period the depressions and irregularities are smoothed over.

Snowfall is extremely difficult to measure on account of drifting with the wind. It is unusual to have enough snow for travel on the land until late December. The grass protrudes through the snow on the level land most of the winter and in order to obtain sufficiently deep snow for igloo building it is necessary to find a drift. The surface condition of the snow has already been described as packed hard and whipped by the wind into waves. In the large drifts each wind adds a new stratum and it has a fairly uniform consistency of hardness and fine grains, but without the crust formed by thaws. The consistency of the drifted snow is such that it may be cut into blocks for igloo building, and may be handled quite freely. If a block should have a fall it would break with a curved fracture.

The surface of the snow is usually so hard that it is scarcely marked in walking over it, except on the grassy flats. There the grass keeps the snow from packing. There is never any occasion to use snowshoes in winter travel on the sea ice or on the open plains. The fact that the winter drifts all lie northwest and southeast with the northwest end undercut, may be accepted and



THE SNOW PORCH

Such protections are built about the doors to protect them from the drifting snow. This photograph was taken by moonlight.

the drifts used as a directional guide in travelling. This is very useful at times, especially when a mist is encountered on the sea ice. As an illustration of this, the mail team was caught by a heavy mist about five miles from shore, close to leads of open water. The Eskimo guide held his course towards Eskimo point and after two and a half hours travel reached the coast at a point where some piled stones indicated the portage to the settlement.

Although the snow is packed hard a strong wind cuts off fine particles and drives them along the surface. They are only arrested when an obstruction is met and some of the drifting snow is drawn in by the back draught. As the wind increases the driving snow begins to rise until it may form a scud one hundred feet high that will even obscure the sun. The surface during the winter is dull and does not reflect the sunlight. The lack of shadows during the period when the sun is low makes it extremely difficult to photograph. Snow and sky meet in an almost imperceptible line. The best snow pictures at this time were taken by moonlight, with an exposure of about five minutes.

By March the sun is beginning to have an appreciable effect on the snow surface, producing a glaze and from then on snow glasses must always be worn. They make travel difficult as the temperature is still low, causing the glasses to mist over and with the restricted vision it is difficult to travel through rough ice. Towards the end of April the sun has sufficient heat to soften the surface of the snow and melt the ice on the komatik runners. The 24th of May is taken as the date for the last travel on the land with sleighs at Eskimo Point. About the beginning of May whale-bone or steel runners are put on for ice travel and by the end of May water on the ice, holes and cracks put an end to ice travel.

The early thaw is chiefly by direct evaporation into the air. It is not until May that the thaw has sufficiently advanced to form icicles. By the 20th of May the snow is melting fast, the land begins to appear on the ridges and pools of water accumulate. The duration of the spring season varies from year to year. It ends in the latitude of Tavane between June 15 and July 1, when the snow is all gone except the big drifts and the new growth is well started. The big drifts are of a purely local character and should not be given importance in the seasonal phenomena. They are formed on the lee (the southeast side) of high, abrupt hills where a tremendous amount of snow is gathered by the back draughts. Drifts under observation remained until early August. It is possible that some of the larger ones do not melt completely during the summer.

During the latter part of May, sleet and rain may be expected and in June snow flurries are exceptional. Showers are frequent during this month but the amount of precipitation is not great. The summer of 1929 was exceptionally dry. Baker lake was reported to be at the lowest level on record and many small ponds dried up. By the beginning of September snow flurries may be expected and through these rather than by heavy falls, snow gradually accumulates on the land. It is usually not sufficient for good travel until Christmas.

ICE PHENOMENA

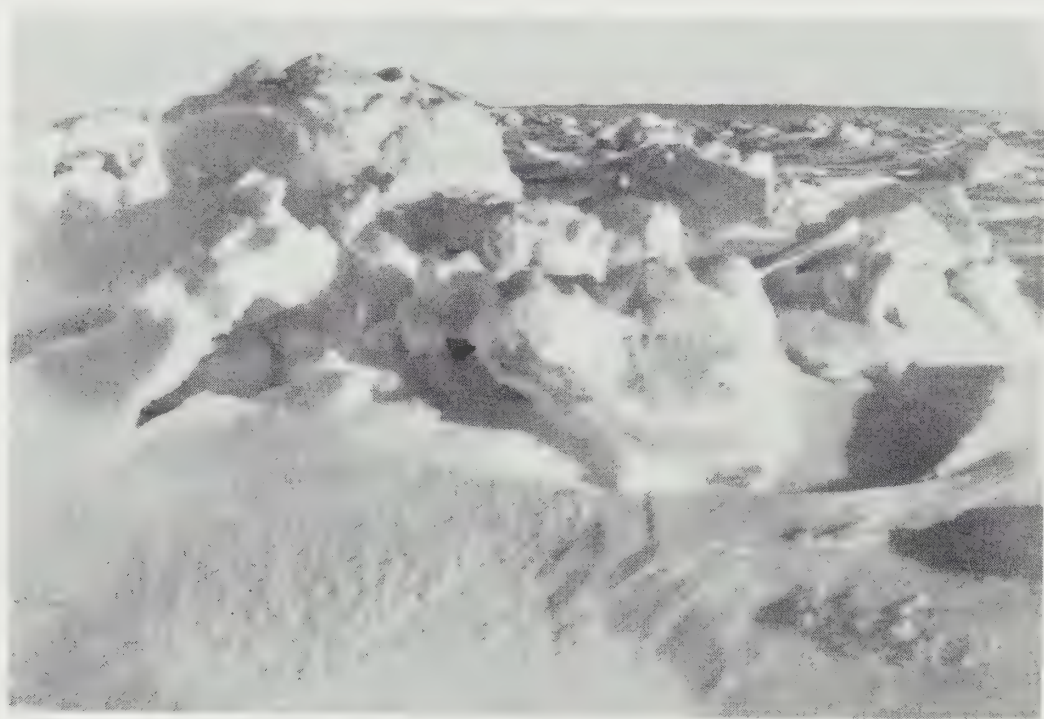
Frosts early in September are sufficient to set the ice on the small lakes strongly enough to resist the heavy fall winds. On the larger lakes, however, ice forms and is broken up a number of times before it finally sets along the shores and forms floe ice in the open stretches. Finally these are cemented together by new ice until the whole lake is frozen over. Baker lake is typical of the large bodies of fresh water of this latitude. It was safe for navigation in 1929 until the middle of October. The date any year will depend more on the winds than the temperature as the water is at freezing temperature from early in October. Ice continues to form quickly and reaches a thickness of at least six feet by April. Many of the small lakes freeze to the bottom.

Salt water freezes at a temperature of 28° F., but the freeze-up is delayed by tidal action and the winds. The first ice is what is called "slob", which is of a slushy nature and it gathers along the coast in bays and shallow water. The "slob" checks wave action and permits young ice to form out from the shore. As in the case of large lakes the freeze-up now is controlled by the winds. It is probable that bay ice will form and be broken up several times before it sets securely as a rim along the shore.

In sheltered water, or on calm days the young ice spreads from the shore ice in band after band. In other places floe or drift ice forms until the sea becomes congested with loose cakes of various sizes. These are caught by a new ice formation in a calm to form larger floes or to join the fixed ice. Gradually the ice spreads out from the shore and beyond are the floes which are driven about by winds and tides. A stable condition is not reached until January when the land-fast ice has extended to fill the inlets and major bays and to form a rim several miles wide along straight coasts. The floes approach close in to the points and become attached to the fixed ice in periods of calm weather only to be broken off by the next gale.

It is probable that there is drift ice filling much of Hudson bay during the winter. It is difficult to make observations on account of the mists which rise from the open water and resemble the smoke from forest fires. They form cloud banks which have characteristic forms under different weather conditions. In very cold weather they tend to disappear while in mild weather they spread and settle as ground mists. On aerial observation flights made during the spring when visibility was good, a number of different conditions were found. At times the sea to the horizon was filled with ice and at others much open water separated the ice fields.

Salt-water ice is tougher than fresh and more rubbery when thin. The salty surface is wet until it is covered with hard drifted snow which usually is not until after Christmas. The character of the ice surface varies according to the winds of the freeze-up period. The various conditions include the rough ice of the tidal beaches, smooth bay ice, rough cemented floe ice, rafted pressure ice, and young ice or the ice forming at any time during the winter when the sea is still. The Eskimos have developed a wonderful "ice-sense" by which



ROUGH TIDAL ICE

Each boulder on the beach raises the ice above it into rough piled-up masses, sometimes twenty feet high. As the ice melts in the spring it is found that most of the boulders have been lifted and are on top of the ice. Some of them drop back through holes but many are carried away with the ice.

they can judge the nature of the ice and recognize dangerous conditions at a glance or by the sound when struck with a knife.

Sea ice in Hudson bay reaches a maximum thickness of about five feet. Measurements during winter and early spring gave the following data: November 5, seven inches; November 21, fourteen inches; November 28, eighteen inches; February 28, sixty inches; April 30, sixty-eight inches. The drifting snow fills up irregularities on the surface and builds drifts among the rough pressure and tidal ice and over the whole surface the small wave-like drifts are formed. The drifting by the winds of winter is heavy but the snowfall is light. In April and early May snowfall is heavy and storms are often easterly. These give rise to a new set of wave-like drifts at right angles to the old ones, producing a checker-board effect. As spring advances the snow on the sea ice settles, the drifts become ice ridges and the included spaces pools of water, unless cracks or seal holes permit drainage. This surface makes a bad condition for aeroplane landings and take-offs and for travel generally.

The Eskimos judge the spring ice by watching the holes and cracks, for it is by the weakening effect of these that the wind and tide finally move the ice out. The aerial view of the sea ice in late June is interesting. It can be noted that the seaward border of the fixed ice is built up in bands which are separated by wide cracks as the melting advances. One by one these are carried away by the wind to join the drifting floes. Inshore the ice on the tidal flats melts and leaves a margin of open water along the shore. This tidal ice had formed a barrier between the sea and the inland streams (excepting the large rivers) and it is only after its removal that the fish have access to the sea from the small streams discharging from the inland lakes.

Usually by the end of June the ice is detached from the shores and separated into large fields by cracks and it only requires an off-shore wind to carry it away. The final departure of the ice often starts suddenly and unexpectedly. A movement of the whole body of the ice a foot or so a minute is observed, travelling with the wind or tide. It slowly increases its speed and gathers



THE TIDAL HINGE

The melting of the snow in spring revealed a complete separation of the ice of the tidal beaches from the outer ice that rose and fell with the tides.

momentum, the narrow strip of water widens until in the course of a few hours it becomes the open sea again with the gleam of the drifting ice fields showing on the horizon and scattered berg-like masses looking like ships sailing across the open space. This is one of the most dramatic episodes of the northern spring and an important event in the life of the people for, when the ice goes out, it seldom is seen again and the activities of summer commence.

The ice observed during the spring of 1929 had been reduced to a thickness of under two feet before it was carried away but the break-up was more than two weeks later than usual. From the condition of the ice when last observed it could not last much longer and the ice found drifting in the southern part of the bay in August must have had a different origin, probably from Foxe channel. Salt-water ice does not "candle" in melting but remains solid green ice, perforated by holes and broken by cracks.

It was found that the ice cleared from Roes Welcome about two weeks earlier than from the coast to the south. On account of the heavy set of current along the deeply indented coast between Fullerton and Eskimo point, local conditions will affect the formation and break-up of the ice. The Eskimos living here make a practice of hauling out their whale-boats on the



NATIVE TYPES, NORTHERN COAST

The Eskimos on the west coast wear their hair long, while on the Ungava side they cut it.



ESKIMO TYPES,—ESKIMO POINT PADLEIMIUT

The striking features are the eyes, well formed nose and general oval of the face.

prominent points as being the localities first freed from the ice. Southward from Eskimo point the coast line is very straight and much of it has a very wide tidal beach. Along this portion of the coast there is a very narrow rim of land-fast smooth ice. If there are outer shoals they will hold the ice but will cause rafting and pressure ice to form. Where deep water approaches the shore, as it does in the vicinity of the 60th parallel, there is danger of great fields of outer ice breaking off with the winds at any time during the winter and there even the in-shore fixed ice becomes very rough and broken.

Another important feature, affecting travel on the shore ice, is that of flooding by high tides, over the shallow water ice that is frozen to the bottom and fresh water overflows at the mouths of the larger rivers which continue all winter. These localities are known and may be detected by the appearance of the ice. It is necessary to examine conditions each time a crossing is made.

The spring break-up of fresh-water lakes is similar to that in the south. The sun causes the ice to "candle," producing a disintegration by vertical weakening while the ice is still thick. The thinner ice around the shores melts and the surface water received lifts the loosened outer ice, permitting a movement with the winds which breaks up the weakened ice. It was observed that many of the shallower lakes had ice adhering to the bottom long after the surface was clear.

TIDES AND CURRENTS

Few observations have been made in Hudson bay of tides and currents. The main stream of the Arctic current discharges through Baffin bay, southward. Off the Labrador coast it has a width of over one hundred miles and its rate of flow is about twenty-five miles a day. This is the stream which carries the Arctic ice and icebergs. There is a considerable southerly drift through Roes Welcome into Hudson bay and a larger one through Foxe channel, chiefly into Hudson straits, but partly into Hudson bay. In Hudson bay itself the current sets southward along the west coast and returns northwards along the east side, entering Hudson straits with a heavy set around Wolstenholme.

The currents are complicated by high tides and the ice drift is influenced by winds. Icebergs are carried into Hudson straits from the Atlantic by the tide but only for a short distance. They are finally discharged into the Atlantic by the combined ebb and current. The discharge of Foxe basin ice normally is carried off by Hudson straits but it may be driven into Hudson bay by a period of strong north winds. There is probably a large area in the central part of Hudson bay which is little affected by currents in which ice accumulates and moves with the winds. Such ice appears to gather towards the south or southeast of the bay.

The set of the currents along the Hudson Bay coasts is established by the movement of drift materials. Gasolene drums carried away from Chesterfield came ashore about 300 miles to the south and walrus killed north of Eskimo point also drifted southward. There is no driftwood carried north along the west coast but on the east side of the bay it is found far past the limit of the woods. The action of these currents is important as regards the navigation of Hudson bay. If ice were encountered when proceeding from the straits to Churchill it would be safer to avoid it by passing north and west. Advantage might be taken of these currents by planning the inbound route to the west and the outbound to the east.

The tide advances into Hudson bay from the northeast. Its periods as compared with Churchill are $3\frac{3}{4}$ hours earlier at Fullerton; 3 hours earlier at Chesterfield; and 2 hours earlier at Tavane; showing an advance along the coast of about 150 miles an hour. Tides were studied at Churchill and found

to agree closely with those of Harwich, England. At Tavane sufficient observations were made to show fair agreement with Churchill in period, but two hours and ten minutes earlier. There is a heavy tide race up Chesterfield inlet which reaches to the entrance of Baker lake. Strong tide rips are found among the islands and inlets of the coast. At the narrow entrance to Churchill harbour the tidal current reaches a velocity of about eight miles an hour.

The rise and fall of the tide varies considerably at different points but little dependable data is on record. At Tavane it was found to be about twelve feet at springs and six feet at neaps. An exceptionally high September tide with an on-shore gale reached eighteen feet. Tides of twenty-five feet are reported at Burwell and eighteen to twenty feet at other points. It is probable that the figures for Tavane are a fair average for Hudson bay.



SCHOONER *MORSO* OWNED BY DOMINION EXPLORERS

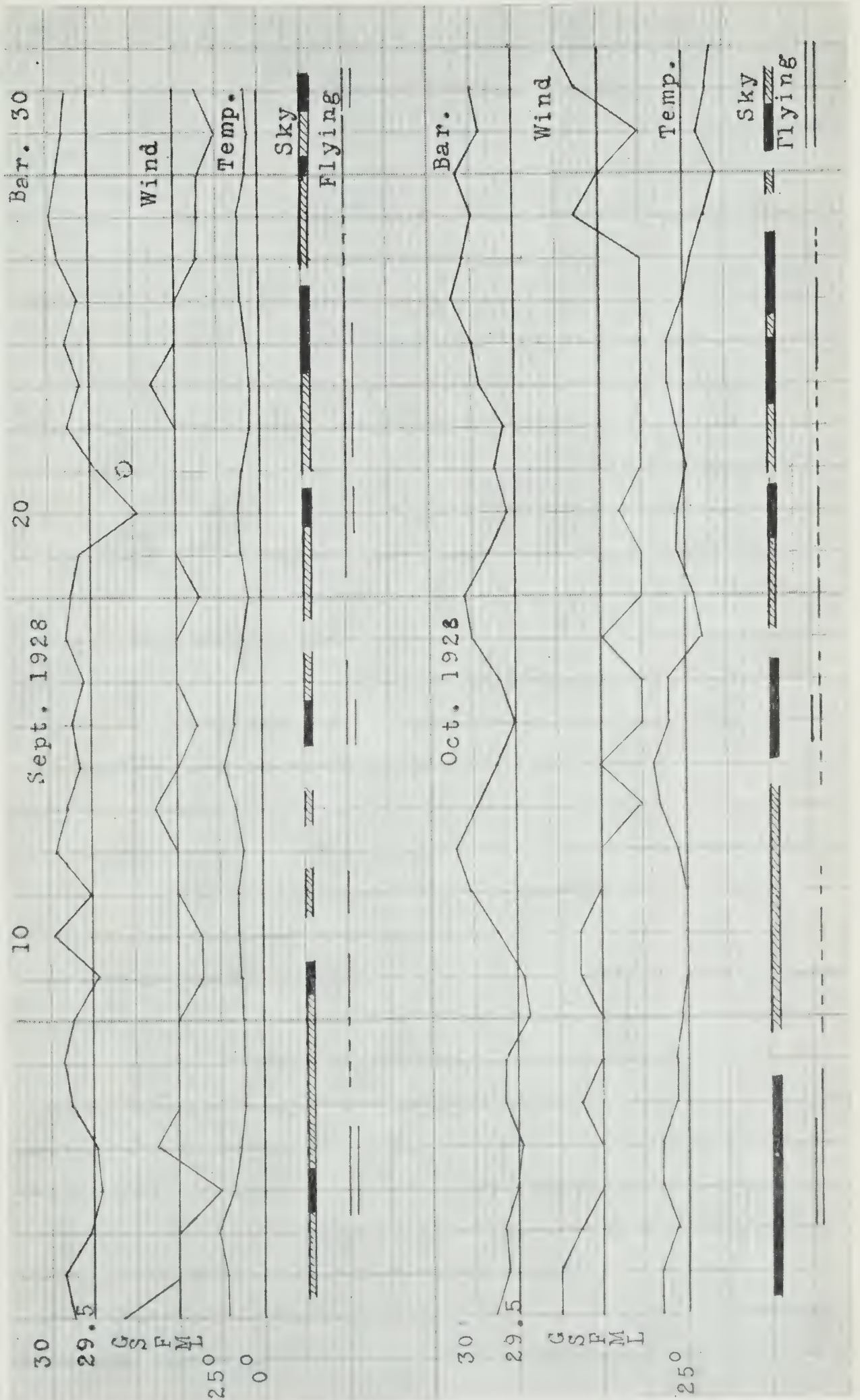
The *Morso* sailed up Chesterfield inlet and crossed to the west end of Baker lake proving that these waters are navigable for craft of fair tonnage.

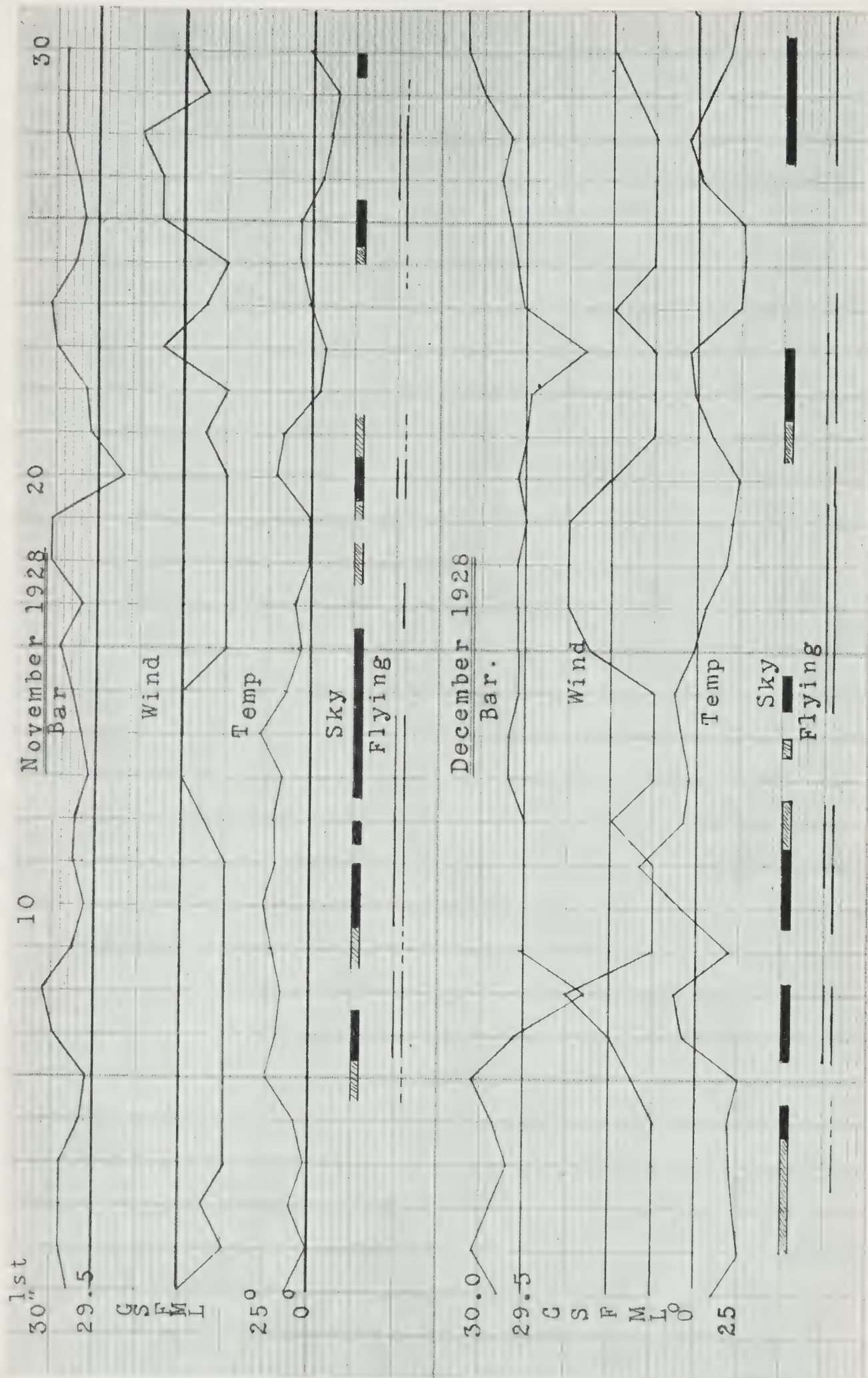
METEOROLOGICAL CHARTS

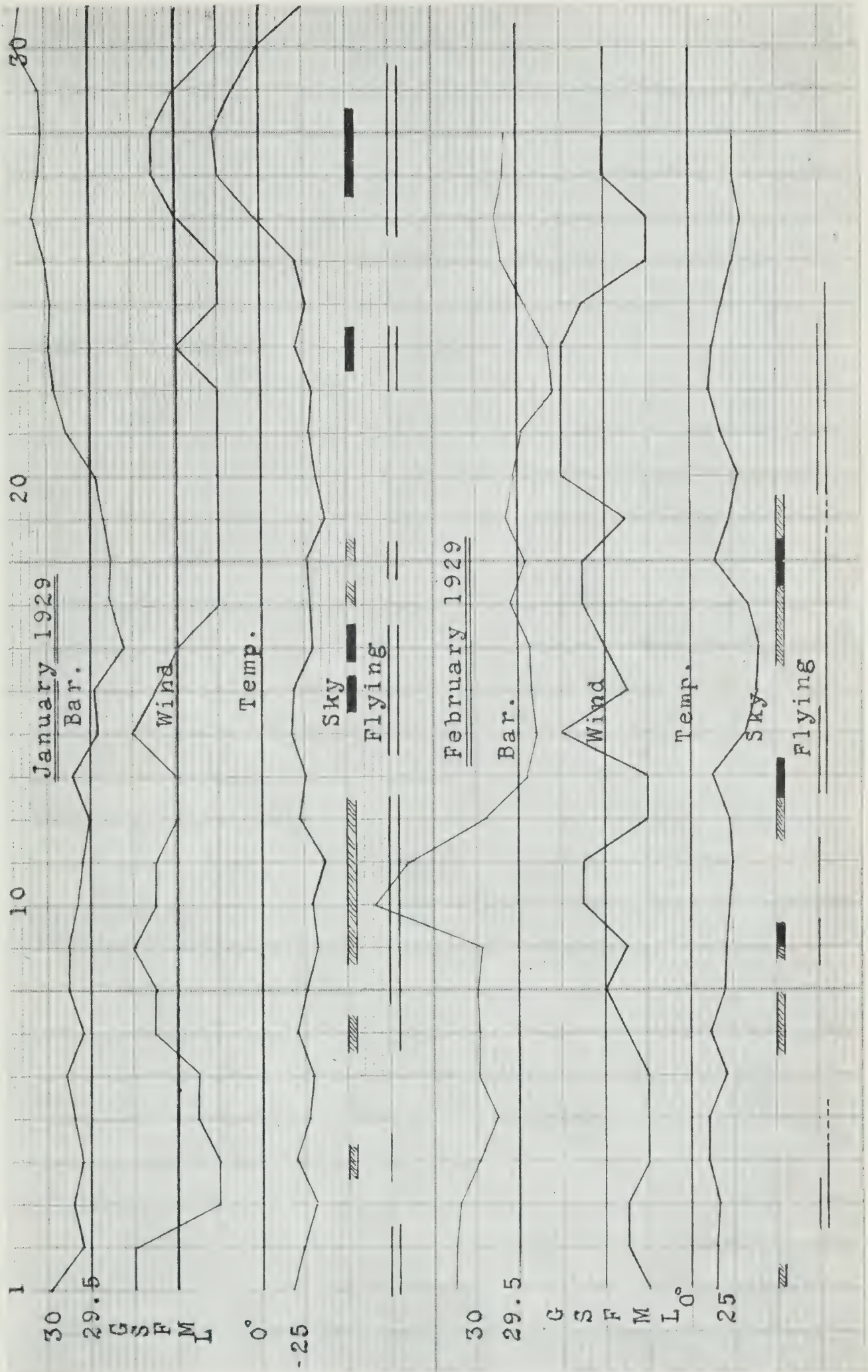
The following monthly charts express graphically the daily mean barometer, wind strength, mean temperature, cloudiness and flying conditions as recorded at Tavane, Hudson bay. From the charts it may be observed to what extent the barometer gives warning of high winds and the relation between wind, cloudiness, and flying conditions, bearing in mind that high clouds may give good visibility and fair to good flying conditions.

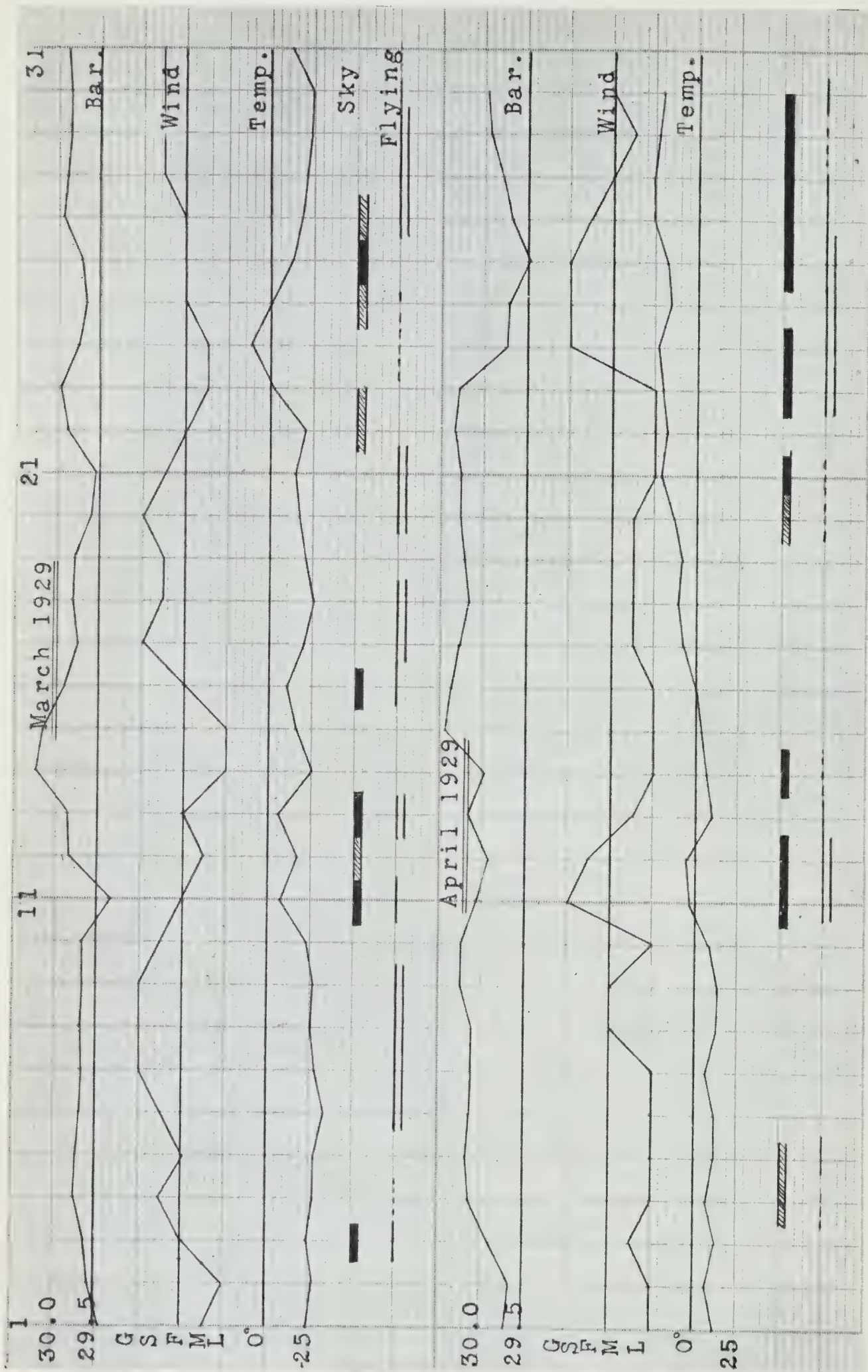
The daily classification is necessarily a broad generalization to express characteristic conditions. It may be seen at a glance whether a month is windy or if the temperature is high, low or variable. The classification of winds is an arbitrary one. A wind of 15 miles is called fresh (F); 25 miles, strong (S); and higher than 30, a gale (G). Calm to 7 or 8 miles is classed as light (L) and about 10 miles, moderate (M).

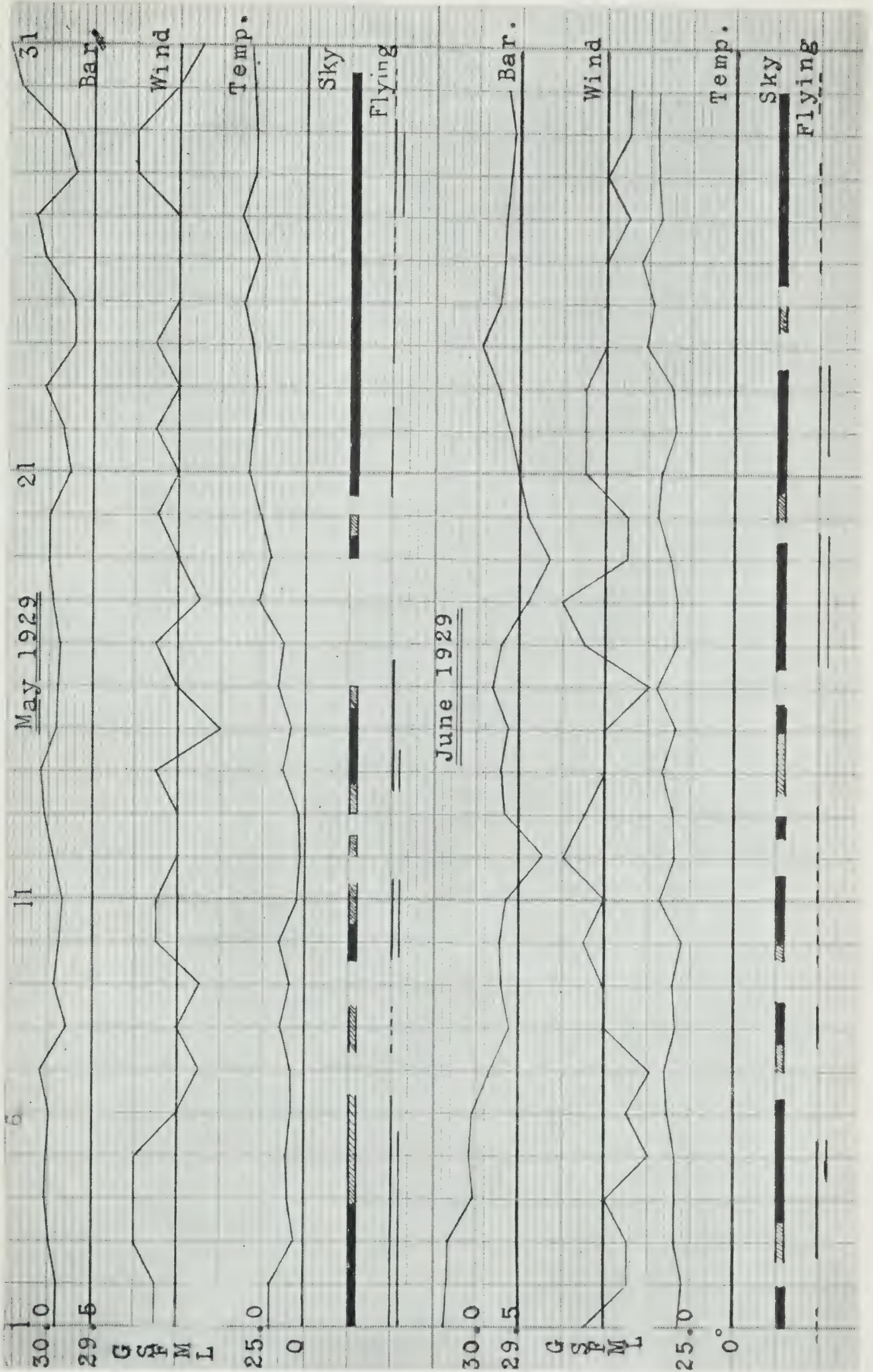
The temperature is the mean of the maximum and minimum. Three conditions of the sky are shown as, black for overcast, hatched for cloudy, and blank for generally clear. Flying conditions are classed as nil, double line; poor, single line; fair, dotted; and good, blank.

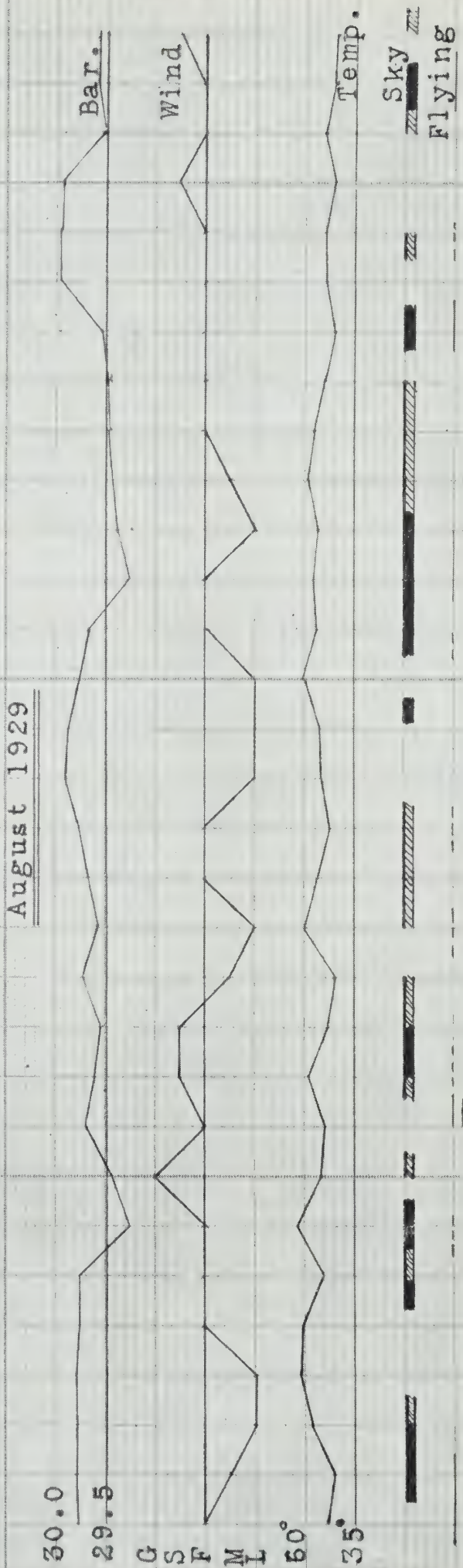
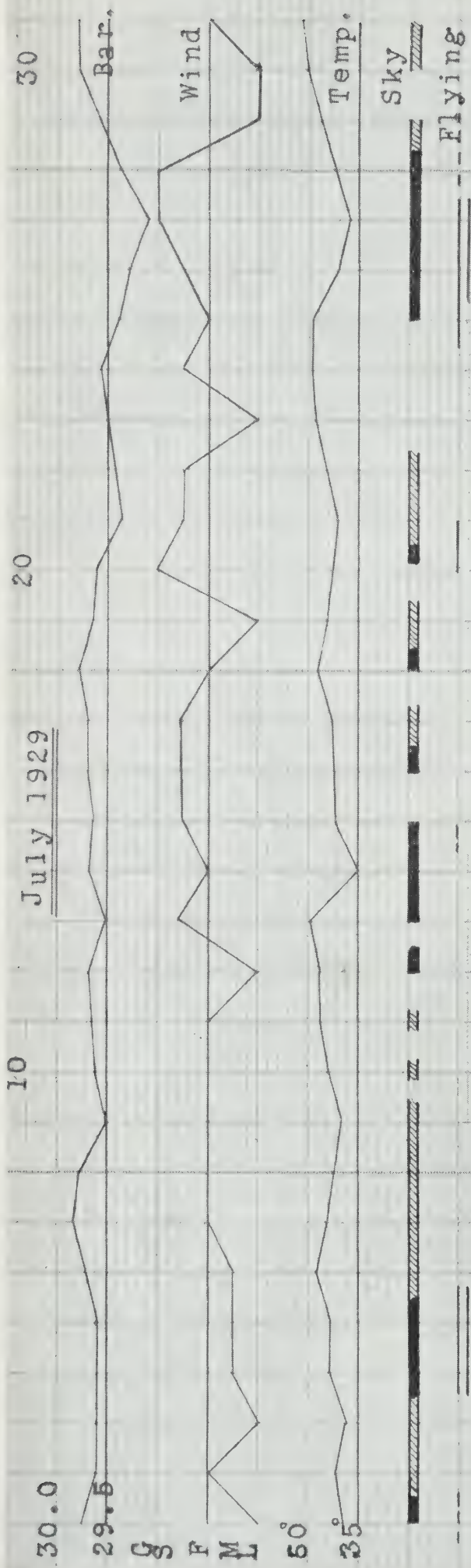












FAUNA

WILD LIFE OF THE LAND

THE CARIBOU

The caribou of the northern plains of Canada has been studied at many points by a number of observers. His general habits and habitat are fairly well known. The weakness of previous observations has been due to the fact that it has been impossible to make simultaneous studies of a comprehensive character. This has been to a certain extent done during aeroplane flights over the country at the period of the fall migration.

The following remarks apply to the country eastward from the line marked by Great Bear, Great Slave, and Athabaska lakes. The previous knowledge of the caribou may be summarized as follows: The calves are born in late May or June, generally in the vicinity of the Arctic coast. The bulls spend the early summer singly or in small bands scattered over the southern part of the open plains. The new horn growth starts in the early spring and the horns are fully developed and starting to shed "the velvet" towards the end of August. The caribou is the only member of the deer family that has horns in both sexes. These are of annual growth and are shed irregularly—by the old bulls in December and January, and by the cows and young bulls not until the late winter and early spring, but in both the shedding is erratic.

The southerly migration towards the woods commences when the storms of August put an end to the insect pest. The scattered herds unite at various points near the edge of the woods for the rutting season in October. The storms of early winter start a movement into the woods and during mid-



THE ESKIMO SLEIGH DOG

This is the common type in the Hudson Bay country. These dogs are very hardy and have tougher feet than those of the woodlands. When they are being fed walrus they receive only one meal every second day.

winter the large herds wander through the woodlands, usually keeping to definite ranges. The cows and young begin their northward journey in February but the bulls do not leave the edge of the woods until the land is becoming clear of snow.

There are recorded observations at a number of points. A migration including a very great number of caribou has been observed at lac de Gras, the head of Coppermine river, lake MacKay, the head of Lockhart river, and at various points about the east end of Great Slave lake, and in the country about the headwaters of Taltson river. Another large migration passes north of Baker lake each year; it was observed along Dubawnt river and large herds winter in the country north of the east end of lake Athabaska.

Formerly caribou were numerous during the winter on lake Athabaska, westward almost to Chipewyan. They reached southward as far as Cree lake and the north end of Reindeer lake. Caribou have always been depended upon for food by the natives inhabiting the country westward from Hudson bay, as far south as Churchill. In the northwest they reached Great Bear lake and



CARIBOU IN THE WOODS ABOUT PADLEI

The picture also shows the type of trees that grow in the outposts of the forest, and the heavy underbrush.

approached the north arm of Great Slave lake. Formerly there was an annual migration from Victoria island to the mainland, but this no longer takes place except in small numbers.

At the northeasterly extremity of Keewatin, caribou were reported numerous in summer about Wager bay and Repulse bay. It was also reported by observers that straggling bands were to be met with in summer and winter that apparently did not follow the seasonal migrations but these were very uncertain in their movements. Owing to the incompleteness of the observations it remained in doubt what relation, if any, existed between the migrations noted and whether the herds migrating past a certain point represented all the caribou of that particular range or not.

The caribou have played an important part in the economic life of the Indians and the Eskimos. For this reason the natives have carefully observed their movements and have been accustomed to meet them at certain definite places at the same time each year. This offers valuable evidence of caribou movements, which have been going on as long as the natives of the country have record.

The northern Indians were divided roughly into two classes, those who subsisted chiefly on caribou and those who procured their living in other ways. The caribou-eating tribes centered about the northwest arm of Great Bear lake, the north and east arm of Great Slave lake and the east end of lake Athabaska. From these centres they set out to meet the caribou about the middle of August at some point in the open plain at which they were accustomed to gather at this season. The hunting expeditions are still made at about the same time and to approximately the same places. During the winter the same people live in the wooded country frequented by the caribou and this is essentially what it has always been, though somewhat forced back by the activities of civilization.

In the course of flying operations in the Northwest Territories during 1929 in connection with mineral investigations and later during the search for the lost Dominion Explorers' party, a wide stretch of the northern plains was flown over at the season during which the caribou were in migration towards the wood-



UNLOADING CARGO AT TAVANE

It is a difficult matter to find a suitable harbour in the reef-filled waters of the Hudson bay west coast. Cargoes must be lightered ashore at high tide.

lands. Due to poor visibility on a number of flights, observations were not as complete as could be desired but sufficient data was collected to present a record of the main movements of the caribou across the country. The more important observations were as follows:—

October—many caribou moving southward in the upper Ferguson River country.

January and February—caribou numerous along Hudson Bay coast from Dawson inlet southward as far as North Seal river. They also were abundant inland from Eskimo point and from Nunalla. Caribou were reported very scarce in the country tributary to Baker lake.

March and April—caribou moving northward. Those noted were chiefly cows and yearlings.

June—caribou numerous in the vicinity of Padlei, moving northward.

August—many caribou were seen in the country north and northwest of Baker lake. They appeared to be moving northwesterly.

September—in early September many caribou were observed in the vicinity of Angicuni lake, Kazan river and at many points on the upper Kazan. These were to a large extent bulls. Towards the end of September caribou were numerous in the country of the upper Dubawnt river and here too these were mostly bulls. Neither caribou, nor their tracks, were noted in the lower Dubawnt country.

October—caribou were fairly numerous in the country north of Beverly and Aberdeen lakes. These were chiefly cows, yearlings and calves and they were moving rapidly westward.

Late October and early November—no caribou were noted in the country between Back river and the Arctic coast.

Late November—in several flights northward from Fort Reliance, caribou were found to be passing around the east end of Great Slave lake in very great numbers.

To summarize this evidence it appears that practically all the caribou have left the more northerly part of their range by the end of September. During the rutting season in October great numbers have gathered in the country of the upper waters of Dubawnt, Kazan, and Ferguson rivers. The large herd noted in November near the east end of Great Slave lake has been observed a number of times at its seasonal gathering place about the headwaters of Coppermine river and lake MacKay. During the midwinter the herds circle about extensive areas of woodlands and later, first the cows and young and then the bulls, start migrating northward to the open plains.

It is true that the high-powered rifle permits more slaughter of caribou but on the other hand the natives are less dependent on them than formerly for food and clothing and do not hunt them as extensively. The principal part of the life of the caribou of the mainland is spent in the southern border of his range near the edge of the woodlands. At some of the extreme southwesterly points his range has been encroached on by the advance of civilization, both directly and indirectly as by bush fires destroying the winter feed of the caribou. The Indians still meet the early migrations at traditional points and winter among them in much the same localities as their forefathers did. There were variations in localities and numbers in the past, and still are, and from the point of view of ground observation the migrating herds still appear to be countless and the relations of the migrations remain difficult to determine. The non-appearance of caribou at a point at which they are accustomed to resort at a certain season has led to the assumption that they were being killed off.

Aerial observation, with its wider scope and the speed of travel by which widely separated districts can be studied almost simultaneously, will permit accurate records to be compiled. From the aerial observations already made it appears that caribou are thinly scattered over a tremendous area except during periods of concentration. Seasonal food conditions, weather and fundamental instincts, and their enemies and pests cause them to move rapidly across their great range. The great seasonal movements are complicated by erratic wanderings. Age-old routes are abandoned when their food is destroyed by fire or when they are unduly disturbed by firearms. Nevertheless, great herds exist which in general follow the habits as noted in the oldest records. It is probable that their numbers have been overestimated in the past and that undue significance has been given to casual irregularities and natural deviations. It may also be reasonably concluded that the present herds of several millions are not greatly less than those which formerly existed in this central area and that their migrational habits are essentially the same as they have always been.

DOMESTICATION OF THE CARIBOU

The Hudson bay coastal plains northward from the timber line include great areas of well-watered lowlands which support a good growth of grass, while in the southerly portion of it willows reach a fair development. Except for an occasional boulder there is nothing on these plains to arrest the wind-driven snow which for the most part sweeps across it without settling, making no more than a thin cover on the grass. Grass tops protrude through the snow practically throughout the winter.

Another important consideration is that the snow does not pack hard enough on the grassy plains to prevent caribou from reaching their feed by pawing. Many caribou remain in the open plains both summer and winter and where they were observed north of Eskimo Point they were feeding on grass. There appeared to be herds, local to this area, which ranged from the country of upper Ferguson river and Yathkyed lake (Ciggaliguak)—where, according to Eskimo reports, the young are born—to the timber country north of Churchill. The



ESKIMO TYPES,—QAERNERMIUT FROM ROES WELCOME

These people show the influence of the whalers who formerly wintered amongst them.

Eskimos of the country south of Chesterfield inlet are essentially inland people and subsist chiefly on caribou. They have very little sea culture or traditions and speak of the caribou as being unchanged in numbers and movements in so far as they have knowledge. It would seem that this section of the country furnishes the caribou with a good living and through most of the year they are disturbed but little. The Eskimos hunt them only in certain localities and at certain seasons and wolves are scarce.

The district is well situated for a reindeer range. It has the natural advantages of food and climate and in addition to this the problems of transportation are simpler than in any other part of the country. By sea or by the Hudson Bay railway the markets which might be created could be reached economically. The possibilities of the range lands of the northern plains of Canada for reindeer grazing on a large scale are of great interest. The presence

of large herds of the closely allied caribou prove the existence of food supplies and the suitability of the climate. From observations made the country should be able to support very many more than it does at present.

The natural increase of the reindeer when protected and under observation as in Alaska is a large one. The difficulties and failures met with to date may be put down largely as those attending the pioneering stage of a new industry.



AN ESKIMO NURSE-MAID

The upper garments are made loose to permit carrying the child next to the mother's body in cold weather. A thong about the back fastens to ivory or wooden buttons in front.

THE WOLF

The chief economic importance of the wolf in the Far North is his relation to the caribou. During the fall and winter he must find the greater portion of his living from the caribou herds. The question of the wolf as a menace to the caribou has been seriously considered and steps have been taken to conserve the latter by encouraging, by bounty or otherwise, the killing of wolves.

During the spring and early summer the wolves are widely scattered about the country in pairs, while the young are born and brought up. Their food at this period consists chiefly of small game, ptarmigan, hares, mice, eggs, and so forth. In the fall they leave their dens and range for their food more widely. At first the band consists of the family and they follow the migrating caribou where they meet other small bands and may unite with them. A band of five to eight is the most common but there have been well authenticated observations of packs as large as 30 or 40 hanging about the caribou in migration. It is probable that these large packs are loosely united and of a temporary nature on account of the large amount of food required to feed so many.

Summer observations of wolves are, of necessity, scanty on account of the limited travel through the interior of the northern plains where they breed. At

the same time few have been seen at this season by travellers who have crossed the country at various times and places. When the caribou begin to gather at the edge of the woods the wolves make their appearance and until the urge of the mating season draws them northward in the spring they remain with the caribou, ranging through the outskirts of the forests.

It is known to the Indians that distemper periodically kills off large numbers of wolves, otherwise their natural increase would be far in excess of those killed and dying naturally. There is no evidence to show that the number of wolves is increasing. If anything, there should be fewer wolves now than formerly. The Indians had a taboo against killing wolves, and it is only recently that they have been hunted seriously due to the encouragement of the bounty making it profitable, especially in summer when a litter may be obtained.

The late Mr. John Hornby, the noted northern traveller, had an unusual theory that the presence of wolves was a benefit to the caribou herds in killing the old and the unfit. It is claimed by those in the best position to know that normally a caribou can outrun a wolf. Wolves are wily in their tactics and secure their game more often by out-manoevering than out-running them. There is a large area in the interior of the northern plains in which conditions as affecting wild life are still primitive and, there, a natural balance has been reached among themselves and with their environment. In the scheme of things arrived at, the caribou and the wolf and all the others play their part.

THE FOX

In the past the caribou supplied food and clothing to the natives of the north. The fox had little or no value until the introduction of the fur trade.

The fox peculiar to the Far North is the white-coated variety, with more rarely its blue phase. Like most of the denizens of the sub-Arctic, nature has provided it with protective colouring—a mottled black-and-tan in summer and white in winter—which makes the animal almost indistinguishable against the background. It lives in burrows in the sandy ridges and is extremely prolific. A litter of twelve to fifteen is normal and one as high as twenty has been observed. Foxes feed chiefly on the small life of the land, hares, lemmings, and ground squirrels, and birds and eggs when obtainable. In the winter they migrate to the coast where they pick up a living from what the sea provides, dead walrus or whales and the remains of seal left by the polar bears, or else they resort to the border of the woodlands where, in addition to the product of their own hunting of hares, ptarmigan and so forth, they clean up the leavings of caribou killed by the wolves. Wolves may prey upon them and, in years in which foxes are numerous, they probably prey upon their own kind. A fox caught in a trap will probably be eaten by other foxes if not soon taken up. During the early period of the freeze-up many foxes are carried out to sea on ice breaking away from the shore. Some succeed in reaching shore after remarkably long voyages which accounts for their appearance in country far from their natural home.

The fur of the white fox is unusually thick and fine and is seldom rubbed on the sides as is the case so often with foxes which inhabit the woodlands. Another advantage which they have is that being white the fur may be dyed any desired light shade.

Foxes in the Far North pass through cycles of from three to five years during which their numbers vary from scarce to very plentiful. In addition to this their migrations are very erratic. For these reasons the returns of fox pelts vary considerably in different districts and from year to year. Fox fur is one of the staple and valuable resources of the North. In the seclusion and protection of his vast breeding grounds and from his native wiliness and abundant reproduction, the Arctic fox should be able to maintain himself indefinitely.

The natural supply of white foxes is to receive an important addition through fox farming. The Hudson's Bay Company is establishing fox farms at those of its northern posts which are suitable, and there is every reason to expect this to be successful. The Arctic fox is less nervous than those of the south and his natural food is usually procurable at the post.

THE POLAR BEAR

Along the west coast of Hudson bay polar bears are found from Churchill northward but they are nowhere abundant. They are usually to be found far out on the ice and seldom come under the observation of the hunter. Several have been seen at Churchill itself but practically no hides are traded south of Chesterfield. Those received at this post usually come from the north. The ice goes out of Roes Welcome comparatively early and the bears take to the shore. Bear meat is welcomed by the natives and the hides serve many useful purposes, those of the young animals for clothing and of the older ones for sleeping robes.

STRAYS

In addition to the animals peculiar to the open plains of the North, strays from the woodlands are occasionally seen. Moose have been killed at a number of points, including Term point, and in the vicinity of Eskimo point, and Baker lake. An otter was taken near Baker lake and red foxes occasionally find their way into the open plains. Woodland caribou are frequently found among the herds of the small Barren Land caribou west of Hudson bay. In general, however, the line of the edge of the woods is a sharp biological boundary.

SMALL MAMMALS

The Arctic hare is quite numerous in the country to the westward of Hudson bay. They frequent rocky country in which they find cover and they dodge about the boulders in the same way that the snowshoe rabbit does about the bushes. In winter they are absolutely white, except for the tips of their ears which are black; and are almost indistinguishable against the snow except when in motion.

Ground squirrels are numerous throughout the district. They live in small colonies, in burrows, each marked by the luxurious growth of hay due to the local fertilization of the soil. This ripens in August when the squirrels cut and store it in their underground passages. They den up early in September and do not come out until spring. They are hunted by many enemies and are extremely wary—seldom venturing far from their burrows and if caught away from them they take shelter among the stones and scold sharply until the intruder leaves. They have the same habit as the prairie gopher of sitting erect on their haunches and, when their observation convinces them that danger is near, of diving into their burrows giving a sharp whistle. They are one of the Eskimo's food resources in time of scarcity.

SEA LIFE

The waters of the northwest coast of Hudson bay support abundant life. Beyond that which is known and has been studied, the presence of certain mammals proves the existence of the marine life on which they feed.

In the past, whales were numerous in Hudson straits, the northern part of Hudson bay and generally in the Eastern Arctic. For many years they were extensively hunted by whalers from Scotland and New England. Until a few years ago whaling stations were maintained at a number of points, and

Depot island and Marble island off the west coast of Hudson Bay were favourite wintering places for their ships. The intensive hunting almost exterminated the right whale in these waters and the industry now has been abandoned. Occasionally whales are still seen in Hudson straits and in Roes Welcome. The narwhal is fairly common in the vicinity of Repulse bay and the white whale frequents the coastal waters. These were particularly numerous in Rankin inlet where large numbers were observed during the course of flying operations along the coast. They are sometimes taken in seal nets and are prized for dog feed.

From Eskimo Point northward, walrus are numerous. They are "bottom feeders" living on shellfish which they turn up with their tusks. In summer they gather about some of the outer islands in large colonies and during the breeding season in August large numbers of males, females, and young may be seen on these islands, and in the bordering sea bulls engage in combats. At this season when they are on the land they are easily killed with spears or rifles and the Eskimos have been accustomed to meet them there and kill their



THE SPRING HUNT ON THE SEA ICE

During the winter the walrus keep to the edge of the floes and the seal hollow out in the hard snow over their holes "igloos" where they have their young in March. The melting of the snow in spring destroys the shelter and the seal are easier to kill.

winter's supply. Others are shot in the water and may or may not drift ashore down the coast. A stranded walrus attracts foxes to its locality and furnishes good winter trapping.

The islands to which the walrus resort have been their gathering places as far back as records go. Their names attest to this fact, such as "Ivik" (walrus island) off Pistol bay; "Oogleakuk" (getting walrus), near Term point. It is reported that walrus are so numerous in certain localities about Southampton island that the Eskimos avoid these waters with their whale-boats. It is a debatable point whether or not the walrus is dangerous to meet in a small boat. Unquestionably he sometimes attacks by hooking his tusks over the sides and capsizing the boat. Natives who have hunted the walrus extensively hold him in respect and speak of him as vindictive. It is probable that ordinarily his approach to a boat is due to curiosity but if wounded or during the mating season a walrus will show fight. The uses made by the

Eskimos of the walrus are for food, chiefly for their dogs; to a limited extent for their hides, and as fox bait. The ivory of the tusks is carved into many useful objects. Walrus meat makes excellent dog feed. It is readily portable and concentrated, and is unequalled as a strength-and heat-producer.

Seals are scattered along the coast. From an aeroplane flying over the edge of the floes in spring, they were observed in hundreds on the ice and after the ice left the coast they moved inshore, probably living on the salmon trout. Seal nets at Eskimo point and Chesterfield supply the summer demand for dog feed. The Oodjuk, or big square flipper seal, is highly prized by the Eskimo for his hide, which is used for sole leather, dog harness, and many other purposes. They are comparatively scarce and are considered valuable prizes when obtained.

Walrus live on shellfish, and the seals and whales on fish. Therefore, the presence of these in numbers proves the existence of an abundant marine life, at least in the coastal waters. On the other hand, commercial fishing has never been developed in Hudson bay. Ice conditions would prohibit fishing except during the period from July 1 to October 31, but otherwise Hudson bay does not offer undue difficulties for the operations of fishing vessels.

Fishermen in following and searching for cod have sailed far into the North. Cod have been found to enter Hudson strait but do not proceed far up and there is no record of one being caught in Hudson bay, other than the Greenland or rock variety. The evidence may be considered conclusive that the Atlantic cod is absent from these waters, although inhabiting equally cold waters in Baffin bay.

The following observations were made on water temperatures on the voyage north in 1928:—

July 15, vicinity of Belle isle, where cod fishermen were located: temperature 47° F.

July 21, eastern entrance to Hudson strait, where cod are caught: temperature 46° F.

July 23, off Hopes Advance, Hudson strait; temperature 38° F.

July 29, Hudson bay, south of Coats island; temperature 42° F.

It appears that the food of the cod in the early season has some relation to ice melting in the Arctic current. A year with little ice means poor fishing. There may be some relation between the cod and water temperature that makes



SALMON-TROUT OF HUDSON BAY

After the shore ice moves out from the west coast of Hudson bay a run of salmon-trout comes to the coast northward from Churchill.

him avoid Hudson bay. The Atlantic salmon also does not enter Hudson bay although he is found at the eastern entrance to the strait. It will require more intensive study to determine the factors controlling the movements of these fish and there is a field for experiment in introducing them to these waters.

Attempts have been made at various times to study marine life in the deep waters of Hudson bay and there is no doubt that had valuable fisheries been revealed they would have been developed. Although these investigations have been of a casual rather than an exhaustive nature their lack of success must be taken as evidence of the absence of certain species, and perhaps of the scarcity of others, of commercial value.

The following fish of commercial value have been found in the deep waters of Hudson bay: Greenland or rock cod, capelin (a species of smelt), sculpin, flounders (rare), lumpfish (rare), and sand lance. Of these the rock cod and capelin are the most important. The presence of halibut has been doubted, although they are found in the deep waters off Greenland. One is reputed to have been seen recently in the vicinity of Term point. The conclusion regarding the deep-water fisheries of Hudson bay is that these waters are lacking in salmon and cod and that investigations carried on to date have not revealed other species of commercial value in large quantities.

In the coastal waters the situation is more promising. In the spring, after the shore ice leaves and permits access to the sea from inland waters, salmon trout in vast numbers come down from the inland lakes where they have spawned, and they spend about two months feeding on the fry along the coast.

Results obtained from the fisheries at Tavane throw some light on the habits of the trout in this district. As soon as ice formed on the inland lakes nets were set through the ice on a number of lakes. In a lake with an area not exceeding four square miles that discharged by a very small stream, a fishery was maintained most of the winter and two short nets which were lifted twice a week continued to yield between one hundred and two hundred pounds a week. The physical difficulties of operating nets in the cold weather and through ice up to six feet thick are considerable but they could be avoided by the use of shelters. The Eskimos had not previously used nets through the ice but were accustomed to fish through holes with a line and it was known to them that fish could be obtained in winter from most of the large lakes. The species were chiefly grey trout and salmon trout. A fishery on Ferguson river yielded a number of whitefish.



ESKIMOS DRYING FISH. HUDSON BAY COAST

Fish and seals furnish the staple summer food for the natives who live on the coast.

When the ice on the lakes started to break up the fish were observed to be moving toward the sea and at that time they were in poor condition. As soon as the ice blocking the river mouths melted there was a run up stream from the sea of a small, unidentified trout weighing between one and two pounds. Shortly after the land-fast ice cleared, the salmon trout run started. The Eskimos have always been accustomed to obtain them at this season. Nets are set on the tidal beach and the fish come in with the tide and appear to follow along the shore in the shallow water. The quantity of fish taken with a short net was far in excess of that which could be consumed by both men and dogs at the station. Several barrels of fish were salted and others



MARINE LIFE HUDSON BAY

These specimens were brought up in trawling, at a depth of ten fathoms.

were dried. The fish weighed up to thirty pounds each and averaged about eight pounds. They were of excellent quality, fat and firm and varied from pink to dark red. An examination of the contents of their stomachs showed that they were feeding on a small fry about three inches long and of two distinct species.

Although there is some variation in the productiveness of the summer fishery, the run continues until late August or early September when the fish are reported to go up the rivers to spawn. This was not observed. Summer fisheries were maintained at Eskimo Point and Chesterfield and by the natives of

many other points, with results similar to those at Tavane. Small-scale trawling in eight to ten fathoms of water brought up some interesting specimens from the seabottom, including a coral formation and primitive forms. Minute clams are numerous and a shellfish obtained on sandy tidal beaches contained numerous small black and light coloured pearls. Jelly-fish up to a foot in diameter were observed. The fishery possibilities of Hudson bay may be generalized as unproven, but probably restricted in the deep water; and of considerable promise in the coastal waters.



SNOWMOBILE ON HUDSON BAY

This was an ordinary light truck modified with skis and caterpillar tread. It was found to be underpowered for work on the hard snow surfaces. Somewhat the same type with more power and ruggedness would be suitable for light travel in the North.

BIRD LIFE

The only land birds that winter north of the woods are the ptarmigan, and certain hawks and owls, but of these there are very few. The harbinger of spring is the snow bunting. They gather at the edge of the woods and early in April they start to move up the coast, feeding on the grass seed exposed above the snow. The migrational urge is strong as they face extremely severe weather in their flight to their northern nesting grounds. They usually are seen in flocks of 20 to 50, but during misty weather individuals were met far out on the sea ice. It was not until May 12 that buntings were seen at Tavane, 250 miles north of timberline, and they were not numerous until the 25th. About this time the geese arrived and ptarmigan became numerous, still in winter plumage. Other birds were noted daily. My diary shows:—

May 26—Gulls, horned larks, hawks, tern.

“ 27—Five cranes passed over.

“ 31—Birds more numerous, first fly seen.

June 2—House fly (long and narrow) numerous.

“ 3—Lapland longspur, plovers.

“ 5—White rumped sandpipers very numerous on swampy flat.

“ 6—Redback sandpiper.

“ 7—Semi-palmated plover.

“ 8—Old squaw duck.

“ 9—Pair Hutchin's geese, hatching.

“ 11—Leconte sparrow, stilt sandpiper. Two eggs in Lapland longspur's nest.

- June 12—King eider duck. Third egg in Lapland longspur's nest.
 " 13—Fourth egg in Lapland longspur's nest.
 " 16—Eggs in ptarmigan; flocks of phalaropes.
 " 17—Red-throated loon, many gulls, and duck.
 " 20—Bumble bee, ptarmigan's nest with eggs; crane's nest with eggs set.
 Northern eider duck, whistling swans nesting, and geese numerous.
 Eider duck nests on the land, eggs deposited on moss and covered with eiderdown and moss.
 " 25—Small trout running in streams from sea to lakes.
 " 27—White rumped sandpiper's nest with four eggs.
 " 29—Eggs in herring gull's nest.
 July 2—Mosquitoes seen; black-throated loon, Arctic tern. Hatching going on very irregularly. Young in one longspur's nest and eggs just being laid in another.
 " 6—Flowers coming out everywhere.
 " 10—Mosquitoes becoming troublesome.
 " 12—Birds no longer singing except for the chirping. The nesting period is over.
 " 17—Early flowers past bloom. Young birds flying.
 " 24—Salmon trout run along the coast well under way.
 " 29—Broods of geese and ducks seen.
 Aug. 2—Well grown covey of ptarmigan seen.
 " 4—Mosquitoes at their height.
 " 8—The grasses are ripe and turning brown. Most of the flowers faded.
 The big drift at the hill completely melted away.
 " 10—Birds beginning to gather together.
 " 12—Aurora seen again, also stars visible.
 " 14—The end of the mosquitoes on the coast.
 Sept. 1—Berries ripening. Saxifrage turned in colour. Very few birds left.
 Few salmon trout caught in nets along the shore.
 Oct. 5—Ptarmigan migrating south in large flocks.

The majority of the birds that nest in the Far North remain there less than three months. June is the Eskimo "moon of the bird's eggs." The birds have many enemies and since they must nest on the ground they have little opportunity of avoiding them. Nature has given both the birds and their eggs a protective colouring which blends with the ground vegetation. The foxes and wolves take a heavy toll of the eggs and young birds.

THE ESKIMOS

GENERAL CONDITIONS IN KEEWATIN

The only native inhabitants of Keewatin District are Eskimos. Those living south of Chesterfield inlet and in the country to the west were classed by Rasmussen as inland Eskimos, and he considered their culture to be quite different from those of the northern Hudson bay coast and the Arctic.

The seasonal food supply is the determining factor in directing the manner of life of a primitive people, and by adjusting themselves to it their customs are formed. This is clearly illustrated in this case. Northward of Chesterfield inlet, there are few caribou in winter, while on the other hand, the sea provides a good living. For the natives who dwell there, the caribou is important in providing clothing and these animals are met chiefly in migration; most of the life of the people there is passed on the coast or out on the sea ice.

South and west from Chesterfield inlet the situation is different. The interior is chiefly a plain or moderately rolling country, well furnished with waterways for summer travel and also favourable for travel in winter. Cari-

bou are to be found throughout most of the district at all seasons, although the main herds migrate north and south with the seasons. On the other hand at the edge of the fixed ice where the sea mammals resort there is a very unstable and unsafe ice front. In periods of calm weather great fields of floes unite with the shore ice only to be broken off again by the next wind. Life on the land is in general easier and safer and on the sea it is dangerous and often entails great hardship. It is natural therefore that the people dwelling there, even if originally accustomed to sea life, would learn the ways of the land and adapt themselves to them. This would explain the small differences in culture between the two sections of the people.



SPRING TRAVEL BY KOMATIK

The runners are shod with steel or bone at this time and the melting snow permits hauling large loads. The cross stick in front is used by the women, usually to assist the dogs.

The advent of the traders has introduced a new factor into the life of the people by providing a food supply that is not seasonal and in giving value in terms of food to articles which formerly had little or no value—fox skins. The direct result has been to simplify life for the people by providing them with improved means of living: rifles, pots, pans, primus stoves, and other useful articles of many kinds. The indirect results are often of an insidious nature. The change from a hunter to a trapper is a fundamental one. It introduces the ideas of supply and demand, and accumulated wealth. This leads to a new conception for a primitive people, that of an organized society, which tends to establish itself in communities and to give up its former nomadic life, and wherein there are rich and poor. The advantages or disadvantages of this fundamental change of life is a controversial point but the transition period is always a difficult one for them and often results in both physical and moral breakdown. For the people of the west coast of Hudson bay the advance of civilization has had little effect on their primitive manner of life and they still retain most of their ancient customs.

TRIBAL DIVISIONS

They are divided into a number of tribes, each of which possesses its own hunting range. Dialects vary sufficiently to confuse the ear of a stranger but the Eskimo method of word building from roots makes it possible for them to

understand one another even when using apparently different words. This essential similarity of the Eskimo dialects is brought out by the fact that over one hundred years ago Franklin brought a Hudson bay Eskimo as interpreter to the western Arctic and he was able to converse with the natives there.

The tribes occupying this district are:

Ivaliks—centering about Repulse bay.

Tesseooyamiuts—back of Wager bay.

Qaernermiuts—north of Baker lake.

Harvaqtormiuts—"people of the eddy"—the lower Kazan.

Teekjademiuts—"people who have driftwood"—those of Beverley lake.

Tahiuarmiuts—upper Ferguson river.

Shonatomiuts (Haunegtorniuts)—people of Term Point river.

Padliemiuts—people of Maguse River country.

Thaningnamiuts—people of Meadowbank river.

Iglooeaaryukmiuts—"people of the place where there are houses"—the old stone houses of Chesterfield.

The natives who wintered at Tavane belong to the Shonatomiut tribe and include about ten families. During the winter a short vocabulary of useful words was made which is appended. Father Pigeon of the Roman Catholic mission at Eskimo Point is engaged in compiling a dictionary of the Padliemiut dialect which is very similar. The Shonatomiuts are the people of the river which enters at the base of Whale cove, west of Term point. They trade at Chesterfield for the most part, but also visit Eskimo point and Baker lake. Numerous graves of all ages along the Whale Cove river show this to have been their chief gathering place for very many years. The Shonatomiuts have



THE TUPEK OR CARIBOU-SKIN TENT

Canvas tents are now largely used but when necessary the natives can always provide adequate shelter from what the country offers.

not previously been under observation and as they may be considered typical of the inland people a description of their customs and seasonal movement may be of interest as a record.

SEASONAL ACTIVITIES

The year is brought to a close by their annual visit to the trading post in August, which is timed to meet the supply steamer. This is arranged for mutual advantage. As many Eskimos as possible are induced to come to the post at this time to assist with the unloading which involves a considerable amount of heavy work. From the Eskimo's point of view, by arriving with his fur when the new stock of goods is available, he has a wider choice of trade goods. Their winter catch of fox skins is traded in and necessary outfits are obtained for the ensuing year. It may be that goods are required that are not carried in stock—a whale-boat, sewing machine, or some such article, and the order is sent out by the ship for the following year. The visit to the post has also a social aspect. Scattered members of the tribe unite and the news of the past year is exchanged and a certain amount of contact is maintained during their visit with people from other districts.



A NEWLY MUDDED KOMATIK

The mud is heated and water added if necessary, to give it the consistency of stiff dough, when it is applied to the runners. It is then planed smooth and iced.

However their visit is a short one. The fall is approaching and much has to be done during the next few months to prepare for the mid-winter period of the short days. Almost every family has its whale-boat by which they move their outfits to the vicinity of their winter range. Early in September the fleet sets sail, picturesque in itself and in the cargoes and passengers, including the dogs. Points are selected for hauling out the whale-boats as these localities are the last to be frozen in, and they are released first in the spring. Caches are made here of all superfluous baggage and supplies and the people start inland with what they and their dogs can carry, including tent poles which the dogs haul.

They are now in their own hunting ranges in which all the features, lake and river, hill and plain, are well known and in which the seasonal movements of its wild life have been observed for generations. The story of its past as affecting themselves and their ancestors is told by stone cairns varying from a

peculiarly placed single stone which is little more than a sign post, to elaborate monuments which may tell the story of many events. There are also the stone circles marking summer encampments, the stones set for holding the frail kayak securely, stone caches for caribou meat; and everywhere that the people have travelled graves are found, also built of stones and often having the remains of the belongings of the deceased about them. It is sometimes difficult to distinguish a meat cache from a grave but the latter usually is floored with flat stones and is more carefully built. A new grave has all the interstices filled with small stones and moss.

It is essential that caribou be killed during the early fall, both to store food for the period of short days and to obtain skins for winter clothing. The people scatter out onto the land in the localities which the caribou are known to frequent at this season. Their life at this period is nomadic, searching for and following the caribou. They cache the animals where they kill them by covering them with stones and their memory and instinct for location are sufficient to find them months later when they may be completely covered with snow. Considerable hardship is involved at this season, living in tents and meeting the stormy fall weather. An ancient taboo, still observed, prohibits them from working on or sewing caribou skins until they can build igloos and their old clothing is often very dilapidated. As soon as snow has covered the land sufficiently to use sleighs they move to the localities where they left their winter things in cache the previous spring.

THE KOMATIK OR SLEIGH

The komatik or sleigh used by the Hudson bay Eskimos is now almost peculiar to the natives of the district. In the Western Arctic the Alaska sleigh has replaced it and in the woodland the toboggan is more suitable. In devising the komatik, Eskimo ingenuity met and solved a difficult problem. The snow is very hard with a roughened surface and is extremely frosty. The roughness



KOMATIK TRAVEL IN EARLY JUNE

Each dog is hitched with a separate trace to the front of the sleigh.

would cause any smooth surface to swing badly and the frost makes traction extremely heavy. The sleigh devised to meet these conditions consists of two runners, up to twenty feet long, about two inches wide and six inches deep. The front is curved only to the extent of the depth of the runner. The runners

are joined by cross slats which are laced on by sealskin thongs, leaving about four feet in the front free. In the early fall or late spring while thaws may be expected the runners are shod with whale bone or steel runners. As soon as the winter cold has set in mud is chopped from swampy bottomland and thawed and mixed with warm water to a consistency of dough. This is applied to the runners in a thick even layer to the bottom and part of the sides, in cross-section, giving a rounded outline, about an inch thick at the bottom and tapering on the sides. It freezes almost as soon as applied. The bottom is then planed smooth. The last operation is to ice it. This is done by squirting warm water by the mouth, as a Chinese laundryman does, over the mudded surface, brushing it rapidly with a piece of bearskin. The komatik runners are planed and iced each morning when travelling.

The sleigh as so constructed rides over the roughened surface smoothly on account of its length and does not slip sideways as the runners cut the tops of the drifts enough to hold. It is easily directed, especially where most necessary among rough ice, by giving the front a pull or shove when the sleigh is in a state of balance on an irregularity, and friction is reduced to an absolute minimum by the iced surface. The length of the sleigh permits its load to be spread out and kept low which is important when travelling on rough ice.

Conditions peculiar to the country, no trees and few obstructions, suggested a method of hitching the dogs to the sleighs different from that used in the west and south. Each dog is attached separately to the front of the sleigh by a rawhide thong and these traces vary in length. This permits each dog to pick his trail and enables the driver to detect any slackers in his team. The dogs fan out and a well trained dog team holds a certain formation amongst themselves. The driver controls his team by voice with many peculiar sounds which the dogs are trained to respond to, and he corrects them with a short-handled, long-lashed rawhide whip in the use of which he becomes very expert.

THE IGLOO OR SNOW HOUSE

As the late fall merges into winter, living conditions for the Eskimos become easier, for snow houses may now be built. The snow igloo is one of the most interesting features of Eskimo culture in its peculiar adaption to their climate and country. From the researches at many points in the Arctic regions it has been concluded that the igloo evolved from the mud and stone hut, traces of which may still be found. The invention of the snow house at once gave them greater range and more economic safety. They were less dependent on accumulated stores of provisions which are uncertain and difficult to obtain, but could start off boldly to search for food where it might be most readily obtained, knowing that a safe and comfortable dwelling could be built where required from the materials at hand.

One of the greatest dangers in the Far North in the country beyond the trees is to be caught by a blizzard, without shelter. The igloo met this by permitting the Eskimo to build a retreat of the materials provided by the blizzard itself. In the igloo a very nice problem in building construction has been worked out by practical methods. A similar structure of masonry (such as the bee-hive coke oven) requires very careful design and skilful workmanship. Each block must have a definite shape and edges bevelled to precise angles. The Eskimo does this unconsciously following a practice learned from his forefathers and meeting the particular problems with good judgment and dexterity.

The essential operations in igloo building are as follows: A locality is selected in which a moderate obstruction or low bank has caused a shallow drift to form, about two or three feet deep. Should the drift be deeper the layer added by each successive storm would be thick and too soft while if it is

shallow the snow would be too hard and brittle. The Eskimo examines his drift with a slender stick carried for this purpose, which he shoves through the drift at many points to determine its depth and the consistency of the snow. This is an important operation and one to which he gives careful attention.

When the site has been selected two men start operations. A large T is slashed out with the snow-knives and the top layer of snow is removed, to the depth of six or eight inches, in the form of a circle, with a diameter of about eight feet for an average sized building. One man now starts to cut out blocks vertically thirty inches long, fourteen inches deep and four inches wide. Both



THE ESKIMO IGLOO

In devising this winter habitation the ancient Eskimo showed great ingenuity and in constructing it his descendants of to-day reveal great skill and patience.

strength and skill are required to cut these without breaking them. The second man commences his wall by grading an incline, then placing the blocks as received, he sets them to the proper inclination, faces the bearing edges to meet the surfaces against which they rest, with a few rapid strokes of the snow-knife and then with a sharp pat he drives them together, in a position in which the block is supported by its bearing at its base and at its right edge against its neighbour, regardless of the inclination.

The blocks are built up in a spiral, working from right to left (from inside the circle). After four rounds the circle has been reduced from eight feet to three or four feet and the blocks are very steeply inclined. The top is closed with blocks of special shape and the structure is completed with a key block of irregular form, cut to fit the particular shape of the opening and lowered into place by bevelling its edges until it settles home. To obtain sufficient blocks the cutter uses one complete layer, lowering the floor about 14 inches and a second layer from about one-third of the space cut from the lee side, according to the particular wind blowing.

The igloo is now roughly completed. The dome is a hemisphere slightly flattened and, if well built, the interior surface is smooth. The raised portion of the floor is the sleeping bench and the lower third is for storage and cooking. While one man trims the interior the other cuts a temporary hole and crawls out and proceeds to chink the spaces between the blocks on the outside and to build the proper entrance. This is done by cutting a passage to the bottom of the drift and making there a hole permitting entrance to the igloo in a stooping position.

This is the igloo in its simplest form. It may be very much elaborated. The entrance porch may be, itself, an igloo and there may be several such used for storage. There may also be several igloos opening from the porch, each occupied by a family, and compartments may open off the dwelling for special purposes. A piece of ice is set in over the entrance to serve as a window.

The sleeping bench is levelled off and covered with bull caribou hides. When making a long stay it is customary, if possible, to collect the black lichen from the wind swept ridges and to make an insulating layer of it below the skins. Small willows woven into mats may be used for this purpose, also. The door is closed by a snow block or if wood is available a small wooden door working on hinges is used, which is much more convenient.

Originally the only source of heat and light for the igloo was provided by rendered fat of the seal, caribou or other animals. An ingenious contrivance known as the seal lamp was devised. It takes various forms but is essentially a shallow dish, usually made of soapstone. Along one rim a wick of moss or bog cotton is placed, resting in the melted fat and a line of tiny jets of flame is kept by careful tending. The seal lamp furnishes a slow, even heat, most suitable for warming the interior, but on the other hand cooking by it is a tedious process.

The seal lamp has been supplemented, or replaced, to a large extent by the primus stove burning kerosene or gasolene. The amount of oxygen in an igloo is limited and very little change of air takes place through the material of its



ESKIMO TYPES,—ESKIMO POINT PADLEIMIUT

This man's features are striking, even among his own people. The string of beads attached to the ears is an old custom, now generally abandoned.

walls. It is therefore essential to provide ventilation when stoves are burning. This is done by opening a small hole at the base and one in the roof. Should the temperature rise and start melting the roof the hole is enlarged, while if it becomes too cool the hole is stopped with snow. A candle flame is a good indicator of the condition of the air. As long as the flame is bright the air is good but when it dwindles and flickers fresh air must be supplied. Neglect of ventilation has caused carbon dioxide poisoning, sometimes resulting in death when it occurs while the occupants are sleeping.

If the caribou hunt is successful the life of the Eskimos during the mid-winter period of the short days is comparatively an easy one. They gather together usually at some point near the coast where an igloo village is built. The women prepare the skins and make clothing and the men set out their traps for foxes and make occasional trips to their meat caches. The returning sun of February stirs the village to greater activities. Trap lines are extended and hunting trips are made to the winter ranges of the caribou. An Eskimo equipped



ESKIMO TYPES,—PADLEIMIUT

These are characteristic of the natives of this part of the country.

with a snow-knife, rifle and sleeping bag, and with a team of dogs may go almost anywhere. Some of the older people have made remarkable journeys. The sentiment binding an Eskimo to his tribe is not a strong one and he has complete confidence in his ability to meet life wherever he may be. This has been demonstrated in all expeditions into the North which have made use of Eskimos.

CLOTHING

The winter clothing of the people shows an intelligent utilization of the materials available. Caribou hair is round and hollow in cross-section and therefore a good insulating material. Caribou skin is used almost entirely for winter clothing. A complete outfit as worn by the natives of the Hudson bay west coast consists essentially of the following articles:—

The artikee, or inside shirt, is made of short-haired summer skins with the hair inward against the body. It hangs nearly down to the knees and is provided with a poke or hood. This is the sole upper garment worn inside the igloo.

The koletuk, or outer coat, is a most important article. It is practically the same as the artikee, but is slightly larger to go on over it, and is worn with the hair outside. It is made of longer-haired skins and considerable skill and good taste are employed in mixing white and brown fur to produce a tribal pattern. The hood is trimmed with wolverine fur which is not frosted by the breath. Lacking wolverine, dog or wolf fur is next best. The

bottom of the koletuk has a fringe of fine cut caribou strings which are both for decoration and to break the draught. A drawstring in the hood permits partly closing the opening in cold weather.

Poalook, or mitts, are made of the skin from the caribou shank. The hair on this portion is short and strong and can stand considerable wear. The mitts are made just to meet the sleeve and permit most operations to be performed without removing them. The inside of the mitt becomes easily frosted by the moisture of the hand but this is readily melted on account of the insulating fur holding the heat.

Kokaleek is the name given to the trousers which are in the nature of "shorts," hair inside and with leg bottoms wide. Over these canvas shorts of similar shape are worn sometimes.

The footgear is extremely important for comfort and safety and has been well designed. Komeekpuk are short-hair caribou skin stockings with the hair inside which reach a short distance above the knee. Alikteeyuk are stockings, usually of duffle, that go over the komeekpuk. Komeeks are caribou moccasins with the fur inside and to which an extra sole of heavy caribou skin, hair outside, is sewn to save wear and to prevent slipping. This extra sole must be frequently renewed.



ESKIMO SPRING COSTUME

When the weather becomes mild the koletuk or outer coat is discarded and the caribou moccasins are replaced by sealskin boots called mukluks.

This completes the winter costume of the Eskimo and the total weight is about five pounds. It is essentially the same for men and women, though differing somewhat in design. In the case of the women's clothes the artikee poke is enlarged and sometimes used to carry the child, and both in the artikee and Koletuk the front and back are extended almost to the ground. The back is made loose to hold the child in cold weather against the mother's body and the upper sleeves are enlarged to permit moving the baby without taking it out into the cold air. The kokaleeks of the women have the fur outside and invariably

have a strip of dark fur down the sides. The cut of the tail-piece distinguishes a child from a young girl and is different again for a married woman. For spring and summer use the women often have artikees elaborately decorated with beads and fringed with caribou and musk-ox teeth.

There is a looseness about the garments that permits a free circulation of air, entering from their open ends, especially when running. This is an important and necessary provision to prevent the body from perspiring and dampness forming on the inside garments, with the resulting chill when they cool off. Damp clothes are the greatest danger in Arctic travel for it is almost impossible to dry things in the igloo. It is the custom when the hands are cold to draw them inside out of the sleeves and warm them on the body. Children are often observed in cold weather to have their sleeves hanging empty. A set of caribou clothes weighs very little, permits free motion, and ensures the maximum of comfort and safety.

On the Hudson Bay west coast, south of Chesterfield inlet, caribou may be obtained practically all winter. In April the northerly migration takes place, passing some distance inland. By this time the snow has settled on the sea ice, revealing the seal holes and the seal may be observed when they come out. The winter villages are now broken up and the people move out to good sealing grounds where they remain until the shore ice goes out and the salmon-trout run begins. During the spring and early summer they live essentially on seal and fish, supplemented by birds and eggs after the migration sets in. This is the life of the summer until it is again time to repair to the trading posts with their winter catch of fur and the year cycle is completed.

Their movements are directed throughout by seasonal food supply, but this is now being modified more and more by supplies obtained from the trader. The more primitive people still prefer the meat, fish, and blubber of the old days but all are passionately fond of tea, tobacco, and sugar; and flour is coming into use. In summer the fur clothing is to a large extent replaced by trade goods. The conditions under which the Eskimos of the coast and the open plains live tends to maintain their migratory habits and their old manner of life and they are now safeguarded to a certain extent by the food supplies of the trading posts which also offer an asylum for the aged and for others in times of illness.

DOMESTIC LIFE

The domestic life of the Eskimo is of a family rather than tribal nature and the remarkable feature of it is the self-reliance with which a family or an individual will strike out into the country at any season, depending on their own skill and ingenuity to obtain a living and provide the necessary shelter. They are inured to hardships early and learn to accept them without resentment. They are endowed with a simple kindly nature, easily pleased, frank and open in their dealings and generous in sharing their possessions and in offering their services. The northern Indians regard the white man with contempt and among themselves ridicule his peculiarities. Such an attitude was not observed among the Eskimos. They conduct themselves with self-respect, approaching dignity, and meet the white visitor to their country with hospitality and courtesy observing his ways with serious interest, quick to approve what is new and useful and interested in what is strange.

The Eskimo does not drive a bargain. He gives freely what he has and leaves it to the other party to make adequate returns. Should he be dissatisfied with the trade he would probably avoid again having dealings with the one who offered it, but would make no comment. The family life of the Eskimos is harmonious. The men hunt and trap and the women are occupied with the care of the children, cooking, and preparing the skins for clothing. When travelling in winter the wife catches and harnesses the dogs while her husband

ices the komatik and loads it. On the trail she runs ahead while the man handles the dogs and sleigh. In general the women are given the light work but are more continuously employed, while the men are essentially the providers of food and the artisans.

Great affection is shown by both parents for their children, who live a carefree life during their early years. Marriage is arranged by the parents while the children are still young. Equality of age is not considered essential. The relationship is essentially economic—the man to be a good provider and the woman to be skilful at domestic work. The custom of rubbing noses is still retained among the people of the west coast. Their relationships are based on mutual respect which in some cases approaches a sentimental attachment.

There is considerable variation in the types of features among the Eskimos. Among the Padliemiuts individuals with small oblique eyes were noted. As a rule the nose is small and fleshy but it is unusual to have the effect of a flat



NATIVE TYPES, SOUTHERN INTERIOR

The people of the interior are still very primitive. Their only contact with civilization is at the outposts of the traders. In winter they use only caribou skin garments but for summer the clothing sold by the traders have been adopted.

face. Their expression is usually lively and intelligent. The older women have their foreheads, cheeks and chins tatooed but this custom has fallen into disuse. The men almost universally wear their hair long and loose. The older women are untidy in this respect while the younger ones now have the custom of plaiting it.

Chronic diseases are rare. A few cases of tuberculosis were noted but the people are for the most part free from it. The only systematic weakness noted was bronchial trouble which is probably caused by climatic conditions and spread by unsanitary habits in the igloo. They are susceptible to contagion from germs brought from outside, against which they have little resistance. The natives with the mail team coming from Churchill spread influenza along their course and the arrival of the ship in summer is a signal for the outbreak of what is known as "ship's disease," a form of influenza. Due to their bronchial weakness there is a danger of a neglected cold developing into pneumonia which is

almost always fatal and it is difficult for them to give proper care to the sick. A medical station has been established by the Department of the Interior at Chesterfield with a doctor in charge. There the Eskimos may receive assistance when sick and also be taught preventive measures, especially sanitation.

ADVANCE OF CIVILIZATION

The penetration of the white man into the land of the Eskimo has been through whaling activities, the fur trade and the missionaries. The whalers entered northern waters from both the Atlantic and Pacific and in a comparatively short time almost exhausted the supply of whales. Their contact with the natives was casual in the purchasing of whales and the employment of native crews, and more intimate at depots established for reducing the blubber and at winter quarters. The whalers had little influence on the country or the people, of a permanent character.



ESKIMO TYPES,—CHESTERFIELD QAERNERMIUT

One of the older generation with heavily tattooed face but showing the influence of civilization in her clothes and hair-dressing.

The whalers introduced the fur trade to the Eskimos of the northern portion of Hudson bay, and to those of the Arctic coasts. They were followed more recently by the great fur-trading companies who were already engaged in the business in the south. The Hudson's Bay Company extended a chain of posts northward along the Hudson bay west coast, and eastward from Mackenzie river along the Arctic coast, until now the chain is complete in reaching all

the coast natives. Revillon Frères located several establishments on Hudson bay and the Canalaska Trading Company has trading posts on the Arctic coast. The establishments have been located at points at which the natives have been accustomed to gather, and are so situated that the natives of all parts of the coast and adjoining country are within reasonable reach of a station.

There are detachments of the Royal Canadian Mounted Police at Chesterfield and Cambridge bay and one is to be established at Baker lake. Anglican and Roman Catholic missionaries are located at Baker Lake and Eskimo point and the latter at Chesterfield also. The Eskimos are in general in contact with the trader, the police and the missionaries. Wireless telegraph and radio broadcast are removing the isolation of the outposts of civilization. Radio sets are furnished to trading posts situated on Hudson bay and a weekly broadcast to the North is utilized to send messages and official instructions that would require months to reach them otherwise.

During the last few years the activities of civilization have been extended to reach the most isolated outpost, and their influence on the Eskimos have been correspondingly increased. Few Eskimos have not seen an aeroplane and many have travelled in them.

Prospectors have given them a new idea in rocks of value and now in their travels about the country the Eskimos look curiously at the country rock and select specimens with considerable shrewdness.

The ways of civilization are more and more influencing and replacing primitive customs, and imported articles are taking the place of those of native manufacture.

In its advance northward, civilization is considering the resources in the land of the Eskimo. Those resources of sufficient value will be developed as conditions warrant. During this transition stage, the rights of Eskimos must be protected, and they must be assisted in adjusting themselves to their changing environment, and altered manner of life.

VOCABULARY

LIST OF USEFUL WORDS OF THE SONATOMIUT DIALECT

Concerning the water—

Water.....	I mĭk
River.....	Kok
Current.....	In ŭk kăn ik
Waterfall.....	Kol lo nă
Rapid.....	Koig nŭk
Lake.....	Tăs e ôk
Island.....	Kĭk kĭk tăk
Shore.....	Şe nă
Calm.....	Şe lă kik
Wave.....	Mă lek
Sea.....	Mĭk ka lo
Low tide.....	Tĭng e yuk
High tide.....	Oo lĕn y yŭk
Canoe.....	Ky ăk
Large boat.....	Oo me ăk
Schooner.....	Oo me ă yĕt nă
Steamer.....	Oo me ăk soăk
Paddle.....	Po wŭk
Engine.....	Ik kŏmĭ tĭk
Salt water.....	Tar eo

Animals—

Dog.....	Kĭn mĭk
Walrus.....	I vĭk
Arctic hare.....	O kă lŭk
Seal (general).....	Nĕt chŭck
Seal (big).....	Oo juk
Caribou.....	Tŭk too
Caribou herd.....	Ă mel yer ăk
Fox.....	Tĕr e ĩn e ăk
Bear.....	Nă nook
Whale.....	Ă rĕk
White whale.....	Ky lă loo ŭk
Wolf.....	Ă mă hŏk
Musk-ox.....	O mĭng mŭk
Moose.....	Tŏk too wăk
Fish.....	I kă look
Net.....	Mŭ ke too tĭt
Rifle.....	She cow te yout
Shell.....	Kŭk yŭk
Caribou skin.....	Ă mĭk
Ptarmigan.....	Ă ky gle ŭk
Arctic trout.....	Ă look po yŭk
Salmon.....	Ish o ă wăk
Lake trout.....	A ne o yŏk
Crane.....	Kă kig wăk
Loon.....	Kăk sŏw
Duck.....	Ăye yŭk
Eiderduck.....	Me te yŭk
Gull.....	Nŏw oo yŭk
Mosquito.....	Kĭk toi yă

Nature—Weather

Sun.....	Sĭk ĩnŭk
Moon.....	Tăk tĕk
Stars.....	Ood lŏr e ăk
Snowfall.....	Căn dă tŭk
Rainfall.....	Mă ho tŭk
Rain.....	Ne pă look
Wind.....	Ă nŏr e
Weather.....	She lă
Fog.....	Tăk too
Storm.....	Pĭk too ne ăk
Snow.....	Ă pŭt
Ice.....	Se ko
Clouds.....	Noo woo yă

Concerning the land—

The land.....	Noo nă
Boulder.....	Oo yĕr ăk
Cliff.....	Ki ăk tŏk
Grass.....	E vĭk
Black moss.....	Tĭn go yŭk
Hill.....	Kĭng nŏk
Plain.....	Măn e tŭk
Stone cairn.....	E nook shook
Tree.....	Nă pă toot
Barren lands.....	Nă pă too e tuk

Seasons—

Late summer.....	O woo yŭk
Early winter.....	O ke ook sŏk
Winter.....	O ke ook
Summer.....	Oo pĭn găk

The Moons—

January.....	Oo bloo să yŏk
February.....	Ă voo net nĕt chuk
March.....	Nĕt che yĕt
April.....	Tĕr e gloo ĩt
May.....	Nŏr at
June.....	Măn e le ŏr vĭk
July.....	Kău gră lă vĭk
August.....	Să gă roo vĭk
September.....	Ăk kood lĕr ok vĭk
October.....	Ook ke o ler ok, or sĭk ku vĭk
November.....	Ook ke ăd lĭt
December.....	Oob loo e lăk

Time—

Day.....	Ood look
To-day.....	Ood loo me
To-night.....	Oo noo pŭt

VOCABULARY—*Continued*LIST OF USEFUL WORDS OF THE SONATOMIUT DIALECT—*Continued**Time—Con.*

This morning.....	Oog lăk
Tomorrow.....	Kow pŭt, A hă go
Day after tomorrow..	Kow pish ăk
Yesterday.....	Ik pĕ shăk
Day before yesterday	Ik pĕ shăn e

Parts of the body—

Arm.....	Tŭ lăk
Hand.....	Ad gă
Leg.....	Ne vo ă
Fingers.....	E noo kŭt
Foot.....	E te gă
Knee.....	Cĕr ko
Eye.....	E ye
Mouth.....	Kă nĕrk
Nose.....	Kĭn gŏk
Tongue.....	O kă
Teeth.....	Ke yu tet
Hair.....	Noo chĕt
Ear.....	Se oo tĭk
Toes.....	Kek mĭng wă
Shank.....	Kă năk, Kă mă
Thigh.....	Kok tor ăk
Stomach.....	Na, Akerok
Neck.....	Ko wăsh ěn ăk
Head.....	Ne ă ko
Chest.....	Să ke ă
Back.....	Ik se vo tŭk
Tattoo.....	Kă ke nă
Blood.....	Owg
White man.....	Kă bloo nă

Descriptive adjectives—

Good.....	Pa e yook
Bad.....	Pe u ne tŭk
Soft.....	Ă he tŭk
Hard.....	Se te yŭk
Dangerous.....	Măn e yŭk
Straight.....	To ke o mo ă tŭk
Crooked.....	Săn go e ăk tŭk
Far.....	Kăn ing e tŭk
Near.....	Kĭg le ne
Half.....	Kit ěr kăk
Halfway.....	Kă ting ă
Damp.....	Kin e py yŭk
Dry.....	Păn e tŭk
Cold.....	E ke
Warm.....	O ko
Frozen.....	Quŏck
Long ago.....	E tchŭk
Very long ago.....	Ky yŭk
Finish, end.....	Ty mă

Descriptive Adjectives—Con.

Another.....	Hy pŭng ă
Nothing.....	Pĕtĕr hăn e tuk
Short.....	Nă tŭk
Fast.....	Hoo kow to
Slow.....	Shoo ke yet ă
Small.....	Mĭke ook
Large.....	An e ook
This one.....	Oo nă
That one.....	Ig nă, Tă nă
Many.....	Ă mă shoot
Dark.....	Tăk tŭk
Enough, all right....	Nă mŭk tŭk
Hungry.....	Săd lŭk
Shallow.....	Ik kă tŭk
Deep.....	E te yŭk
Same.....	A tchingă
Different.....	A tig e ne tuk
Inside.....	Ig loo me
Outside.....	Se lă me
Too little, too small..	Mik ke koone
Too much, too large..	Ang e koone
Not many.....	De ă kit tŭk
Better.....	Pa chow oon ik sŭk, moo yăk
No good.....	Pe chow oog e tŭk
Too far.....	Wăsh e koone

General—

Aeroplane.....	Ting me ăk
Tractor.....	Noo nă koi ăk
Trail.....	E net
Pipe.....	Poo loo yă chĕk
Matches.....	Ik kă tĭk
Fire.....	E koo mă
Smoke.....	Ich shŭk
East.....	Ne ouk, Kă rŭng nă
West.....	Wă nek, ne mik
North.....	Ă tă wŏne, Kă nĕng, nuk
South.....	Pin gang nŭk, ne gŭk
Snow knife.....	Bŭ nă
Knife.....	Să vik
Coal oil.....	E keŭk
Tent.....	To pĕk
Gasolene.....	Ik ko mil lik e ă
Candle.....	Nă pă tŏk
Lantern.....	Na nĕr o
Book.....	Te tŭk kăt
Map.....	Noo nă ny ka
To write.....	Te ter ăk tŭk
Pencil.....	Te ter ăk
Photograph.....	Ă te

VOCABULARY—*Concluded*LIST OF USEFUL WORDS OF THE SONATOMIUT DIALECT—*Concluded**General—Con.*

String.....	Kǎ meuk shūk
Twine.....	Kip yūk
Rope.....	Ōk shoo nōk
Axe.....	Oo le mo wūp
To sew.....	My hōk tūk
Thread.....	E wǎ lo
Needle.....	Mit kūt

Clothing—

Dress (cotton).....	ǎ te le tă
Inner caribou coat...	ǎr tik c
Outer caribou coat...	Ko le tūk
Hood.....	Pok
Caribou shorts.....	Kōk ǎ lek
Caribou stockings....	Ko mek pūk
Duffle stockings.....	ǎ lūk te yūk
Caribou shoes.....	Kōm ek
Sealskin shoes.....	Mūk lūk
Canvas coat.....	Pǎr kǎ
Cloth trousers.....	ǎ tūk tă
Mitts.....	Po lǎ look

The Family—

Man.....	ǎng ook
Woman.....	ǎng nǎ
Baby.....	Noo tǎr ōk, Ik kǎ tok
Boy.....	Pa yǎr ōk, E noo hook to
Girl (unmarried)....	Ne ve ūk siok
Child.....	Noo tǎr ǎ
Wife.....	Noo le ǎnǎ
Father.....	A ta ta
Mother.....	A na na
Baby.....	Pǎne
Son.....	Er nēg

Interrogations, Pronouns, etc.—

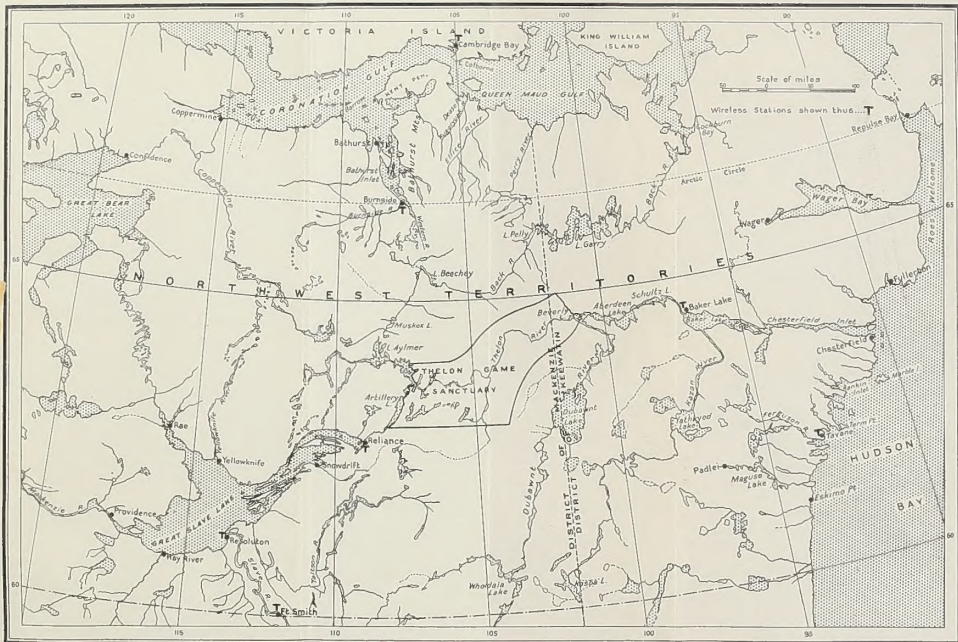
What.....	Shoo nǎ
Where.....	Nǐ ne
When.....	Hǎ nook
Which way.....	Nǎ moot
How far.....	Kǎp she nik she nik (how many sleeps)
What do you say....	ǎ hoo nǎ
What do you want...	Shoo nǎ mik
What does he say....	Shoo nǎ gōk
How do you say that.	Shoo now nǎ

Interrogations, Pronouns, etc.—Con.

Shall we stay here...	Ood le lǎ
Ready now.....	Owd lǎ lik lǎ
Shall we make camp.	Tug ma lǎ
Do you understand..	Too ke shǎ vet
I hear you.....	Too sǎ pungǎ
I do not understand.	Cow you mung ǎ ne mǎ
I do not know.....	ǎ tchook
Make an early start..	E kǎ nǎ yarikt
How many.....	Kǎp she nik
Here.....	Tǎ mǎ ne
There.....	Mǎ ne
Over there.....	Tǎ vǎ ne
I am glad.....	A le ǎn yt
That is so.....	E lǎ le
Possibly.....	Cōl moot
All right.....	Nǎ mūk too
That is enough.....	ǎ hoo.
Wait a bit.....	Chow o pik
Soon.....	Kir ōk
By and by.....	Wǎ chow
It is true.....	E mǎ
No.....	Owkǎ
No (in answer).....	Nōwk
Now.....	Mōnǎ
I.....	Oo vung ǎ
You (singular).....	Igvit
You (plural).....	E lip se
He.....	Ig winǎ, Taim na
We.....	Woo wǎ goo
Them.....	Ig men ik
Give me.....	Pa oo mǎ voo mǎ
Come here.....	Ky le
Where did you come from.....	Noo ke pa weet
Where are you going	Nǎ moot
That is difficult to understand.....	Nǎ loo na koonǎ
That is difficult to do.	I oo nǎ to

Sound Values used in Spelling—

a	as in	ate	ǎ	as in	act
e	"	keep	ě	"	let
y	"	eye	ǐ	"	kick
o	"	moat	ǒ	"	ox
u	"	utility	ǔ	"	cut
oo	"	hoop	oi	"	oil
ow	"	how			



MAP SHOWING AREA COVERED IN THIS DISTRICT.

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